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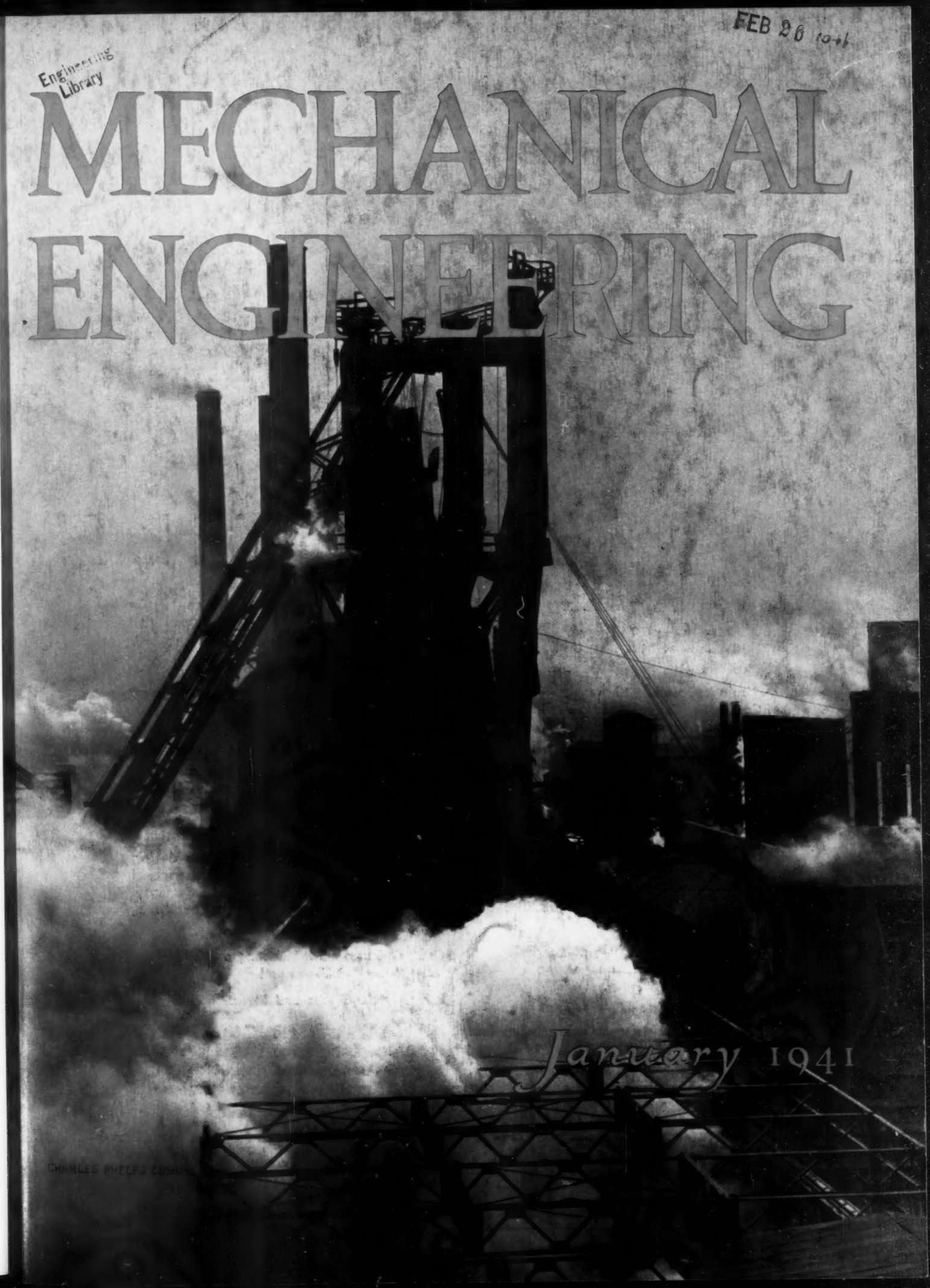

January 1941

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MECHANICAL ENGINEERING

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"Challenger"

(Photograph taken by John J. Mulhern and shown at the Fifth Annual Photographic Exhibit held during the 1940 A.S.M.E. Annual Meeting, Dec. 2–6, 1940, New York, N. Y.)

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MECHANICAL ENGINEERING

JANUARY
1941

GEORGE A. STETSON, *Editor*

A.S.M.E. Professional Data

REPORTS reaching headquarters of The American Society of Mechanical Engineers indicate that confusion exists in the minds of some members about the A.S.M.E. Biographical and Professional Data sheet and the Roster of Scientific and Specialized Personnel. Both should be filled out and returned as promptly as possible.

The A.S.M.E. has made no comprehensive attempt to bring the professional records of Society members up to date since 1935 when a Biographical and Professional Data blank was issued to all members with the request that it be filled out and returned. Although returns at that time were not complete, the information placed on file in the Society's records has been of great value to the Society and to many members as individuals. These records are in constant use at headquarters. They served at the start as a basis for statistics on Society members' interests and engineering duties on which programs of Society development were based. They provided a source of information on new personnel for Society committee work. They afforded lists of members engaged in consulting and other specialized activities to which the staff could turn when inquiries were made by firms and organizations seeking the services of specialists. They uncovered the names of men qualified for jobs that were going begging, and the names of potential authors and discussers of papers. And finally, they afforded recent reliable information of the careers of deceased members that has been of great value in the preparation of memorial notices.

Today, these professional-data records are out of date and very incomplete. In addition to the normal uses to which such records have been put in the past the national-defense program has enormously multiplied the need felt at headquarters for up-to-date and authoritative information on A.S.M.E. members. Government agencies and industrial concerns are searching diligently for properly qualified engineers for specific tasks and naturally turn to engineering societies for help. If the Society had to rely solely on information contained in membership application forms, it would be seriously handicapped in providing promptly lists of its members whose professional experience is greatly needed. Every member can take the first step of patriotic duty in a national emergency by filling out the Biographical and Professional Data record sent to him by the A.S.M.E. and returning it promptly.

The second record blank which all A.S.M.E. members have received or will receive is that of the Roster of Scientific and Specialized Personnel. It is sent out from Washington and the information gathered by it will be put on punch cards for use of government agencies in search of men competent to undertake special tasks in the national-defense emergency. An explanation of the Roster was given on page 701 of our October, 1940, issue.

Because many engineers are members of several scientific and engineering societies, each one of which has provided a list of its members, more than one copy of the Roster blank with its accompanying technical check list will be received. Each member must decide for himself whether the check list sent him is appropriate to his case. For example, if a man is a member, say, of the mechanicals and the civils, he must decide whether, for the purposes of the Roster, he should fill out the mechanical- or the civil-engineering check list. Unfortunately, because of the large number of names on the societies lists, mailing of the civil and mechanical check lists cannot be made on the same day. If the first list received by a member is not appropriate to his case, he should either wait until the right list is mailed to him, or write for the list he wishes to fill out. But here again, filling out the Roster blank and technical check list is a patriotic service that should not be neglected.

There is no connection between the A.S.M.E. Professional and Biographical record and the Roster. The first will be filed and used at the A.S.M.E. headquarters in New York and the second will be filed and used in Washington. Because a member has filled out one does not relieve him of the obligation to fill out the other.

A.S.M.E. Research

RESEARCH activities of The American Society of Mechanical Engineers were advanced during the 1940 Annual Meeting by the cooperation of the Committee on Research and the professional divisions. Following a study of its functions and program reported at the Semi-Annual Meeting in June, 1940, the Committee on Research secured the active cooperation of the Committee on Professional Divisions by the appointment in each division of a research secretary whose duty it will be to head up in the division all its research interests and tie them into the work of the Committee on Research. Many of these research secretaries were appointed by the executive committees of the divisions during the Annual Meeting, and in order to secure effective service they are to become associate members of the Committee on Research. Thus is set up a mechanism for greatly stimulating A.S.M.E. research activities at a time when the nation is in need of all of the assistance and advantage

it can derive from expanded technological knowledge.

But mechanism is not enough. A liaison officer who is nothing more than a channel through which may flow in opposite directions whatever currents of mutual interest mere chance may bestir is performing little more than a mechanical function. Such a channel is necessary in the interests of orderly and effective procedure, but what is of equal importance is the stimulation of currents to flow through the channel provided. This, too, is a function of the research secretary as envisioned by the Committee on Research.

Opportunity exists, therefore, for the active development of research projects by the divisions. The professional-divisions machinery has worked admirably in the formation of programs, the solicitation and review of technical papers, and the holding of meetings. Some divisions have also fed to the Committee on Research, projects in their fields that have been cultivated and advanced to the stage of tangible results. In many cases, however, the research programs have been of a sporadic and opportunistic nature, and little attention has been given to a careful survey of the problems in the field that need solution and are of a nature that can and should be undertaken by The American Society of Mechanical Engineers. Industries have been handsomely served and the Society's prestige has been materially enhanced by a number of research projects undertaken in the past. There comes to mind, for example, the extensive program on the properties of steam which resulted in vastly extending the field of accurate knowledge of this subject, in the publication of steam tables that covered the region of high temperatures and pressures found in modern practice, and in effectively coordinating three great research projects at Harvard University, The Massachusetts Institute of Technology, and the National Bureau of Standards. Here, as in all A.S.M.E. research activities, the Society acted as the coordinator—as a catalyst according to some points of view—by which money was raised and direction given. International interest and cooperation soon developed, and the benefits that flowed from this one project have been out of all proportion to the effort expended by the Society. A wise multiplication of projects of similar importance would vastly stimulate the technical vitality of the A.S.M.E., enhance its prestige, and create those intense professional loyalties that are the lifeblood of scientific societies.

How many similar projects in research await active development the professional divisions are competent to determine if they will make a job of finding them out, putting them forward in proper form through their research secretaries to the Committee on Research, and then, when sanction to proceed with them is granted, assisting with zeal and sustained effort in pushing them through to a successful conclusion. Nor should failure to foresee the sources of financial backing essential to final completion discourage initiation of a potentially useful project. Many projects have modest beginnings. A few hundred dollars may permit an investigator to start and afford him the means of producing the few results that may convince an industry concerned with the problem of the obligation to see it through.

Here is a big job for the research secretaries and the divisions. If they were to turn up enough worth-while projects to require the Committee on Research to meet every month, this voluntary service would be gladly given, and as the results began to filter through to members and the outside world in papers and new techniques, support of the Society in the form of new members and donations to special funds for research activities would inevitably follow.

Many-Valued Logics

MATHEMATICIANS are popularly supposed to discuss subjects utterly devoid of interest to the layman, subjects, in fact, in which even the very intelligent layman fails to find the slightest glow of that warmth of humor or philosophical speculation we sometimes find in scholarly papers beyond our comprehension. But mathematicians themselves are admirable fellows possessing rich human qualities, and the American Mathematical Society has recently been releasing popular notices of their papers which display a surprising talent for publicity technique. One of these concerns many-valued logics.

As if it were not enough that the dictionaries should provide us with several meanings or shades of meaning for the same word, or that Mr. Stuart Chase should write on the subject of semantics to remind us that we are careless in the use of words, the mathematicians have had to invent many-valued logics and to work out the mathematics appropriate to this astonishing contribution to a sense of futility in a search for the absolute.

The smug complacency of the woman who abided by the principles of two-valued logic and marked her pies TM for 'tis mince and TM for 'taint mince is shared by all who assert that something is either so or not so. But when Dr. F. Zwicky, of California Institute of Technology, declared that it would be easier to explain the atoms if he could use a many-valued logic, and asked the mathematicians to develop it for him, the fat was in the fire. Prof. J. Barkley Rosser, of Cornell University, was at least one of those to oblige in a paper before the American Mathematical Society, with what results the Committee on Publicity states as follows:

> The principal result so far is that a many-valued logic turns out to be much more complicated than anyone had expected. The reason for this is that the meaning of every mathematical word depends on the fact that one uses a two-valued logic for ordinary mathematics. Allow more values, and you get more meanings for every word. What nobody had suspected was that you got a great many more meanings for every word. In a three-valued logic, there are 256 distinct meanings of the simple word "and." In a four-valued logic there are 14,348,907 distinct meanings of "and." And so on. All this complication makes things hard for the mathematician, but allows more freedom for the physicist. Imagine how many possible kinds of atoms a physicist could make out of electrons AND protons with 256 kinds of "and" to choose from, and how much more chance he'd have of finding one that worked the way it ought to.

Here is something for the engineer to think about who has been trying to define "up and down" by logic.

THROUGH A GLASS, DARKLY

By W. L. BATT

PAST-PRESIDENT, THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

SOME men I know—and you know them too—insist on evaluating any given situation entirely in terms of historical precedent. Present conditions and future possibilities are judged by them on the basis of the past—by looking backward into time and experience. They are satisfied to rest their judgment in a conscious or subconscious conviction that somewhere in recorded history there will be found a valid precedent for today, and that therefore the chapter of history that follows that precedent will tell the story of tomorrow. Such men look only backward.

Other men completely reject the value of precedent, assume that there is no historical parallel for the conditions of today, and allow their imagination to paint vivid pictures of a future bearing no resemblance to the past or the present. Such men look only forward.

Still others, of course, look neither backward nor forward. They neither bolster their judgment with precedent nor unleash their imagination for a picture of the future. They simply stand pat, blindfolded and helpless.

For my part, I would ignore that third group, and combine the viewpoints of the other two. I would recognize some value in historical precedent as a guidebook on cause and effect as a possible key to the puzzle of the future. But I would not be bound by such precedent to interpreting the future only in terms of the past.

What I am trying to say was once much better said in Paul's first letter to the Corinthians—chapter 13, verse 12:

"For now we see through a glass, darkly; but then face to face; now I know in part; but then shall I know even as also I am known."

The ninth verse of the same chapter reads:

"For we know in part, and we prophesy in part."

I should like to take part of the time I have with you tonight to peer through a glass, darkly; to try to make out from the murky, shifting lines of the present and the future, some hint of what shape they may take when we meet them "face to face."

I do not know how successful we shall be. I only know that this is our duty—that we are challenged by humanity, civilization, and decency and by our own self-interest—to try to see through the glass in order that we may act as wisely as possible.

And why is this such an important duty? What aspect of today makes it so imperative that we forget the pleasures of living this moment and strain our eyes and minds in the difficult task of making out the future? Why? Because there is a war going on all over the world, a war that threatens to destroy all the progress of the human race for hundreds of years without wiping out any of its mistakes. Because civilization is rocking at its very foundations. Because the highest political ideals that man has evolved are in imminent danger of extinction. Because our progress and our civilization and our political ideals are in the balance.

Here we are on the very edge of a world in flames. Our neighbor's house is burning, and unless he can put out the fire with what help we give, it soon will spread to our own dwelling place. In recognition of thi s danger we have set out upon the most gigantic program of armament ever undertaken by any country in history, a program that will roughly double an already great Navy, quintuple our Army, and multiply a projected air program to give us thousands of planes where we have had tens. And yet, I have a definite impression that the people of this country do not understand either the size or the pressing urgency of this undertaking. Too many of us are still thinking in terms of "business as usual." Too many leaders of enterprise are still thinking of their individual competitive positions instead of gearing their respective capacities to the united effort of a whole industry. Too many labor leaders are still engrossed with personal or organizational rivalries. Too many taxpayers are complacently viewing the cost of this program as something that

Therefore it seems to me essential that we immediately create a small group of the ablest men in the country who would be charged with studying these long-range problems and working out solutions in advance. They ought to be set off in a corner by themselves, instructed to forget all about the immediate problems of procuring war material, except as it affects the future national economy. They should set to work now on the preparation of an industrial demobilization plan. Nations have spent decades preparing plans for the conversion of a peacetime economy to a wartime economy. So far as I know, nobody has seriously undertaken the preparation of plans for the opposite process—converting a wartime economy back to a peacetime economy. That might involve the discovery and development of new processes and new products for civilian consumption that could be manufactured on the same machines that now are turning out or preparing to turn out products that are useless in times of peace; plans for the absorption of our newly trained labor in peaceful pursuits; the fundamental policies of a foreign-trade policy in a world that will be vastly different from that with which we have ever dealt before.

This group would need inventors and research scientists, trade experts and fiscal experts, men of practical knowledge and great vision. They should devote their entire time to the formulation of the best plans that could be evolved for the utilization of our entire resources for the improvement of our standard of living, for the protection of our national economy from the repercussion not of war but of peace, for the conversion of the processes of economic waste to the processes of economic usefulness.

An address delivered at the 1940 Annual Dinner, Hotel Astor, New York, N. Y., December 4, 1940, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

somehow will be met without any personal inconvenience or contribution.

I find in meeting people throughout the country that they are curious but uninformed about the fundamentals of our national-defense program. I am told, for instance, that on the "Information Please" radio program a week or so ago, that group of amazingly well-informed men did not know the specific jobs of Defense Commissioner William S. Knudsen, E. R. Stettinius, Jr., and Leon Henderson. How many of you here tonight do?

I do not know where the fault lies or what is the explanation. Perhaps we have undergone a national psychological letdown from the tense excitement of last May and June. Perhaps we are too cocksure of our ability to do bigger and better things than anybody else in the world.

But we are attempting to do more in two years than Germany did in six, Nazi Germany, whose entire national existence was geared to this one job of armament. We are attempting to do more than the British Empire has been able to do in four years, some fifteen months of it under war conditions.

We *must* grasp the enormity of these facts and what they mean. We must somehow jar ourselves out of an attitude which if not complacent is in certainty easy-going.

So before we begin probing into the future, we must first understand clearly the scope and something of the pattern of what we are trying to do right now. We must get it through our heads, by constant repetition if necessary, that modern war is a life and death struggle between the total economic strength of the opponents. That applies not only to war but to defense against war. For you will remember that preparation for the fighting going on today began a long time ago, and that the wiping out of a great city like Southampton is only a phase of that effort. War in the military sense is only the final chapter in the story of a conflict that started years before with the gathering of raw materials, the building of tools, and the planning of production lines. We hope that the names of those of us engaged in today's defense job will never be read in a final, military chapter of this struggle. But we do know that unless we do this job well, our names may play a prominent part—in a tragic ending.

We are now engaged in the struggle to gather raw materials, build the tools, and plan the production lines. Let me say again that this does not mean we must eventually get into war. As a matter of fact, the better we do this job, the faster we build our guns and tanks and bombers, the less chance there is of our ever having to use them.

I mentioned just a moment ago the gathering of raw materials. Now that may not sound so difficult. Not for a nation that is the greatest producer and processor of raw materials in the world. Not for a nation that comes closer to self-sufficiency than any other political unit on the face of the globe. But the United States is not only the greatest producer and processor of raw materials, it also is the greatest user of raw materials. It is the most highly industrialized nation on earth, and its degree of self-sufficiency is only relative. We still must import substantial quantities of fifteen industrial minerals, not to mention the nonmineral raw materials we do not have, some of which, such as rubber, are vital to armament production. The Army and Navy Munitions Board lists fourteen materials as strategic, that is, materials which are not produced domestically at all, or not in sufficient quantities to support a major defense effort. There are seventeen more "critical" materials, which we would have some difficulty in obtaining in adequate quantities.

Now you have been hearing a good deal lately about steel capacity. But all the capacity in the world for fabricating and processing steel would do us no good whatever without chromium and manganese, without nickel and tungsten that go into it. We are confident that our great automotive industry will be able to turn out more and better vehicles of transport for a motorized army than anybody else in the world. But those vehicles are no good unless they have rubber tires on which to roll. Each of these commodities I have just mentioned—chromium, manganese, nickel, tungsten, and rubber—are strategic materials. Unless they are available in the required amounts we might as well go back to flintlocks and horses.

Let me repeat some figures that I already have used on two occasions and probably will use again. The United States normally consumes about 60 per cent of all the rubber produced in the world, about 40 per cent of the world's production of tin, about 45 per cent of the world's chromium, 56 per cent of silk, 40 per cent of nickel, 26 per cent of manganese, and 33 per cent of antimony. All these are strategic materials. The great bulk of what we use of these commodities must be imported, usually from distant sources, over routes that are already closed or threatened with disruption. When you add on top of that *normal* consumption the *abnormal* demands of an unprecedented armament program, and the incalculable but heavy demands of Great Britain, it is plain that we have a staggering task to perform at the very outset of the program to assure sufficient supplies of the raw materials we are going to need.

Remember that we got away to a slow start and that there are many obstacles—problems of production, finance, shipping. It is impossible to know if there is a dead line for completion of the job, and if so, when it will be. This is the task that has been turned over to the Industrial Materials Division of the National Defense Advisory Commission, in which I serve as Deputy Commissioner under E. R. Stettinius, Jr., a man whose job the experts of "Information Please" could not name, but who has one of the greatest responsibilities in the United States today.

There are several avenues of approach to the problem and we must use all of them, must overcome the inhibitions imposed by years of experience with normal business practices under peacetime conditions. Domestic production, if any, must be expanded; new sources close to home must be searched out and exploited; stock piles must be purchased and placed in reserve; substitutes must be discovered and used where practicable; salvage and reclamation schemes must be formulated and tucked away in a bottom drawer for use "if, as, and when." Given time, we can be prepared in this vital sphere of defense, but we never know if we are to be granted the time. It is a big job and many of us have not yet realized it.

I have neither the time nor the knowledge to go into the details of the toolmaking and production planning that also must take place before we have weapons in great quantities, although I should point out that if anyone complains that this program is lagging, he should look behind the scenes a little. There, in quarries and mines and on plantations throughout the world, on drawing boards and in tool shops, is where our national-defense program is now making progress. We have passed the phase of letting contracts. We are, as Bill Knudsen says, "tooling up." Unfortunately, that does not attract headlines. It would be more than unfortunate if the country were to draw the conclusion that we are standing still.

We have a gigantic national job to do. It is, of necessity, barely getting started. *Its urgency cannot be exaggerated.* There will be many and painful delays. Only by the determination—the unswerving determination of a united people—can it be done. So much for the present picture.

But what about the end result of this colossal world revolution and our preparation to defend ourselves against it? What about the future? We must face the perfectly plain, inescapable

and inevitable fact that when this war is over, no matter who wins, the world will not resemble the world of 1939.

I need not elaborate on the differences if the Nazis and their satellites come out on top. But what if Britain wins? Will it be the same old story of the World War all over again, with the same old British Empire under the same leadership restored to a position of world dominance? We need only look to recent developments for a clear enough indication that the answer to that question is "no." I am willing to go on record right here with the assertion that capitalistic imperialism and individual control of great financial and economic power is as dead in England today as the feudal system. The social and financial aristocracy that has directed the affairs of the British Empire for so long has seen its day.

The British working men—the wage earners of the lower and middle classes—are the ones who have borne the brunt of this war's terror and in whose hands now rests the fate of the empire. It is they, not the old leaders, who cry out: "This war will bloody well be fought to a finish." Britain may go down, but no compromise settlement will be engineered behind their backs. Their spirit is the soul of England today—our guarantee that if we send help, it will be put to the use for which it was intended. And they are in the saddle. When the fighting is over and Britain has won, they will remain in the saddle. Whatever the precise form of England's government, I should think that you can put it down as a fact that one of her leaders will continue to be Ernest Bevin, now Minister of Labor, a trade-union leader with a record and personality and capacity for governing that has earned him the respect of all England, including his former political opponents. Do not forget that two out of seven members of the War Cabinet—Bevin and Herbert Morrison, who started as an errand boy and became one of the ablest administrators in Britain—belong to the Labor Party. They are taking on more and more influence and responsibility, not by backstage maneuvering, but because this war is being fought by the middle and working classes. And these men, as representatives of those classes, are taking on an ever-increasing share of the burden of government. London might well have been lost during the worst days of the early air raids if the transport workers had not been willing to carry on; but they did carry on, not only because they were brave men and devoted to their country's fight for life, but also because they were satisfied that they were represented in the government and would have something to say about things when the war is over. According to Bevin, the war must be followed by "economic reconstruction of the whole foundation of society . . . . . The task of rebuilding the world has to be done by the working class."

There, then, is a phenomenon of great importance: If Britain is victorious it will be because of a new kind of leadership—a leadership of the working people, of the people who stand the brunt of the struggle, out of whose burning sacrifices has grown this epic soul. British labor has been a hundred years trying by one means and another to reach this leadership—it now has it.

Yes, you say, but Britain is at war and war breeds fundamental changes, while we are not at war; we are only building up our country's defenses. Stated simply, that is true. But if we are to build our defenses high enough and fast enough to be as safe as we can in a dangerous world, we must do some things that will affect our economy almost as much as active participation, perhaps more than Britain's early war effort affected her economy. For as recently as the middle of June last, the conservative and sedate London *Economist* had this to say: "British industry, by and large, has until recent weeks been making the maximum effort compatible with no disturbance to its continuation now or to its profit-making capacity hereafter."

And let us remember one other thing; that the most violent disturbance to our own national economy during the World War took place not while we were participants, but before. It was during 1915 and 1916, when our export trade was twisted and distorted, and our eventual Allies were placing huge munitions orders in our industrial plants, that we whirled down the road to inflation, that commodity prices increased by 100 per cent and more, and that wages and the cost of living doubled. It was then that we began to change from a debtor to a creditor nation, shipping out of this country in the twenty-five years following 1914 thirty-two billion dollars more in goods than we brought in.

Are we not now engaged in a program which will have still more profound effects on our nation and its relationships to a world whose make-up we cannot even clearly imagine? I think so.

Once again our export picture has undergone a complete change as a result of the war to date. Our normal peacetime sales abroad of agricultural and consumer goods have been almost entirely replaced by war material. Cotton and tobacco and typewriters and apples are not being sold abroad now, but in their place, airplanes, machine tools, and army trucks, and materials like iron and steel and copper needed by British war industries.

While this is going on, our own defense program is tending to make us more than ever self-sufficient, reducing our dependence upon purchases abroad. When this emergency is over and we are trying to convert our defense factories into producers of consumer goods for sale abroad, we shall find that we require fewer products and materials from abroad than ever before. And you know that foreign trade must work both ways. We cannot sell to other countries unless we, in turn, buy from them. Specifically, the more manganese we produce domestically, the less we buy from foreign producers, and the fewer dollars they have with which to buy our cotton and apples and electrical appliances. Out of sheer necessity we acquired a chemical industry during the World War, and we are likely to acquire new industries and new sources of materials out of this emergency. Once it is over, will we repeat the old formula of subsidies of one kind or another to maintain war-stimulated domestic production? Will we put up another Smoot-Hawley Tariff to close our markets to foreign goods, and thereby close foreign markets to our goods?

This is only one of an array of vital problems that this war and our national-defense program are creating for us. *Industrial problems:* What to do with the excess manufacturing capacity we are creating. *Labor problems:* Where to find jobs for the men we are training for the production of wartime products. *Political problems:* Who is to own and operate the plants that the government is building or paying for in one form or another. *Financial problems:* What to do about the federal debt incurred by necessarily huge spending for defense. *Monetary problems:* What about the gold base when we own most of the gold in the world. All these and many more will present staggering difficulties. Am I, then, a pessimist about the future? Only to the extent that I am convinced we have our work cut out for us; that there are dark days ahead unless we look realistically at what is happening around us.

Well, what can we do about it? We have said that whether we like it or not, whether we send more help to Britain or none at all, whether we become an active participant or remain on the side lines, this war has and is and will have a tremendous impact upon our national life. No matter who wins, the world will be fundamentally changed, and we shall have to deal with new and startlingly different sets of circumstances. The twin facts that a world war is in progress and that we are engaged in

a defense program that cannot help but have tremendous repercussions throughout our national economy, means that we must constantly keep an eye to the future effect of what is going on today, both in the immediate future and the long-range future.

We must examine our every move for its short-term effect on the economy. Shall we permit marginal demands to upset our price structure by simply sitting back and letting the supply-demand situation adjust itself? Specifically, should we permit the price of copper to go up two cents a pound because we are going to need a little more copper than we can produce domestically at the going price, an increase that would cost the nation's consumers $40,000,000 a year and threaten to touch off a price spiral that might lead to general inflation? Or should we take some action such as importing a small pool of copper sufficient to care for the marginal demand, and thus keep copper prices where they are? Or take the problem of steel capacity. Yesterday's paper carried a story in an inconspicuous corner of the financial page that steel mills will boost operating schedules to 96.9 per cent of capacity this week. "This week," continues the story, "will see the greatest amount of steel ever produced in a similar period."

We have been charting this upward movement in the steel industry's operating rate for many months in Washington. We have also been finding out from the Army and Navy what the defense demand will amount to. Probable British needs have been estimated next. Finally, we have added in the probable nondefense demand, which will naturally increase as the effect of defense spending is felt. Stacking this total figure up against present steel capacity, we have about come to the conclusion that added capacity is the only alternative to rationing.

I am convinced that the steel industry must enlarge its capacity, and I see indications that the industry realizes it too.

But the mere adding of new capacity will solve only our immediate problem. We must look ahead to the day when steel operations will be severely curtailed, and we must set up machinery *now* for systematically retiring our old and uneconomic capacity when that day comes.

These are examples of the type of problem that presents itself from day to day as we go along with the program. Such problems alone are enough to tax the men who are engaged in the immediate and urgent task of arming the nation. But there are others, more complex and long-range, for which these men have no time.

Therefore it seems to me essential that we immediately create a small group of the ablest men in the country who would be charged with studying these long-range problems and working out solutions in advance. They ought to be set off in a corner by themselves, instructed to forget all about the immediate problems of procuring war material, except as it affects the future national economy. They should set to work now on the preparation of an industrial demobilization plan. Nations have spent decades preparing plans for the conversion of a peacetime economy to a wartime economy. So far as I know, nobody has seriously undertaken the preparation of plans for the opposite process—converting a wartime economy back to a peacetime economy. That might involve the discovery and development of new processes and new products for civilian consumption that could be manufactured on the same machines that now are turning out or preparing to turn out products that are useless in times of peace; plans for the absorption of our newly trained labor in peaceful pursuits; the fundamental policies of a foreign-trade policy in a world that will be vastly different from that with which we have ever dealt before.

This group would need inventors and research scientists, trade experts and fiscal experts, men of practical knowledge and great vision. They should devote their entire time to the formulation of the best plans that could be evolved for the utilization of our entire resources for the improvement of our standard of living, for the protection of our national economy from the repercussion not of war but of peace, for the conversion of the processes of economic waste to the processes of economic usefulness.

It is, as I said earlier, immensely important that we try to see through the glass, darkly, to make out at least the type and possible shape of the problems we shall meet face to face in the future. And when we discover that these problems will be many and varied and of tremendous significance to our future well-being, then we must meet the next challenge of duty, which is to undertake immediately the formulation of plans for their solution. This was entirely ignored during the World War, and we have not yet rid ourselves of some of the problems that might have been solved before the war was over, if we had had the foresight to do it. In the meantime, a new war has come along that will create changes of far greater importance. The men who are devoting their time and efforts to the solution of our armament problem have no time for worrying about the disarmament problem. If we wait until the end of the war, it will be too late.

There is, in Washington and elsewhere, a general recognition of the importance of planning for postwar adjustments. But as far as I am aware, there is no coordinated thinking along these lines, no organized group with a specific directive. I think that there should be, and I hope to see it accomplished in the near future, for there is no time to waste. If I have seemed pessimistic in some of the things I have said, let me now prove that I am really an optimist. I sincerely believe that if we tackle this problem of postwar demobilization of industry and man power with all the energy we are now devoting to the opposite process, we can build an economy and a standard of living the like of which the world has never dreamed of. We can, in that process, lay the groundwork for an industrial system that will have as its only limits the limits of available man power for production. This system would be based on a price structure designed to reach a vast reservoir of potential consumers that have in the past only been able to afford the basic necessities of life.

We would, then, not only be making plans for the demobilization of a wartime economy, but also planning for the mobilization of all our resources—human and material—for better living in a world at peace.

FIG. 1 SLIDING CLAY BANK AND FLOODED EXCAVATION

FROZEN-EARTH DAM *at* GRAND COULEE

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THE valley of the Columbia River at the site of the Grand Coulee Dam has been eroded to a depth of about 1500 ft below the level of the surrounding tableland. Following the period of erosion, the Columbia River valley is thought to have been obstructed by a glacier thus forming at the present dam site a deep, quiet lake in which ultrafine sediment was deposited to a depth of 500 ft. The melting of the glacier permitted the river to return to its original channel and at present it has cut down through the sediment to within 20 or 30 ft of bedrock, leaving sloping deposits against the canyon walls.

These deposits of ultrafine sediment have been the cause of several large earth slides during the progress of excavation. The major slide on the west side of the river was stabilized by the removal of the overburden to a flatter slope, and by weighting down the toe of the slide with a heavy rock fill. On the east side of the river, the major slide occurred upstream from the dam in the area known as the east forebay slope. Preliminary investigation of the bedrock in this area, by means of diamond-drill borings, revealed the presence of a ravine crossing the dam site in a north and south direction. This ravine was about 100 ft in width and 100 ft deeper than the general plane of bedrock at elevation 880.[1]

Excavation plans were made on the basis of a forebay slope of $1\frac{1}{2}$ to 1, starting from a point in the bottom of the ravine, at about elevation 761. As excavation progressed, this slope became unstable, resulting in a minor slide, and was reconstructed to a ratio of 2 to 1. The 2-to-1 slope was successfully excavated to the bottom of the ravine. As it was quite evident that another slide was impending, the contractor built a concrete retaining wall across the ravine a short distance upstream from the axis of the dam. On top of the concrete retaining wall was started the construction of a rock-filled timber crib. When the timber crib reached elevation 815, the slide suddenly became active, deeply burying the timber crib, and so filling the excavation as to force the withdrawal of the contractors' excavating machinery. No additional work was done on the toe of the slide until after the period of high water in the summer of 1936.

The sedimentary material composing the slides consists of

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[1] "The Use of Refrigeration in Building the Grand Coulee Dam," by Grant Gordon, *Refrigerating Engineer*, vol. 33, 1937, pp. 13–16, 89–92.

FIG. 2 FROZEN-EARTH DAM

about 20 per cent of particles of colloidal fineness, and was deposited in a great series of horizontal layers, each about 1 in. in thickness. In this state, the material had sufficient strength to stand with a vertical face of moderate height; but when once it was disturbed, it became unstable at slopes steeper than 4 to 1.

During the period of high water, the forebay slope above water level was excavated to yet flatter slopes ranging from $2^1/_2$ to 1, to 3.15 to 1. As soon as the river fell below elevation 965, the top of the east cofferdam, the unwatering of the east excavation was started, and there soon appeared a crack along the top of the slope, indicating that the slide was again active. Between the bottom of the ravine and the top of the forebay slope was a difference in elevation of about 300 ft. To stabilize this material, by excavation to a slope of 4 to 1, would have required the removal of an almost prohibitive amount of earth, and would also have resulted in excessive delay in the progress of construction.

It was during this period of unwatering the excavation that the expedient of using mechanical refrigeration was decided upon as a means of controlling the slide. As the deep ravine served as a chute through which the sliding earth flowed into the main excavation, a barrier of earth frozen across the ravine would both obstruct the flow of material and raise the elevation of the toe of the slide, thereby flattening the forebay slope and exerting a stabilizing influence on the slide as a whole.

DESIGN CONSIDERATIONS

Although refrigeration had been used, particularly in Europe, in the sinking of shafts, no data were available as to the structural strength of frozen earth or the rate at which it might be expected to yield when under stress. However, certain basic assumptions were made, and the design of the frozen dam was undertaken. An arched dam located on top of the rock-filled timber crib appeared to be the most practicable. The contour of the walls of the ravine at this point was particularly favorable for the abutments of an arch of 105 ft radius; also the strength of the arch would be greatly increased by freezing it well into the timber crib. The only disadvantage of the proposed location was that it was so near the main excavation that all earth downstream from the dam might fall away and leave the face of the frozen material exposed to the weather, thereby increasing the loss of refrigeration.

Soundings taken in the impounded water over the site of the proposed dam showed that the surface of the slide was at elevation 855. As the top of the timber crib was at elevation 815, the resulting height of the frozen dam was 40 ft.

For estimating the earth pressure to be resisted, the assumption was made that the material composing the slide would weigh 90 lb per cu ft, and that the mass had sufficient fluidity so 75 per cent of this weight would be exerted against the dam as hydrostatic pressure. At a depth of 40 ft, a hydrostatic pressure of 2700 lb per sq ft might be expected; and, on the basis of an arch 100 ft in length, 105 ft in radius, and 20 ft in thickness, a compressive stress of 100 psi might be realized in the frozen earth against the abutments. It was also assumed that the support obtained from the timber crib might reduce that stress by one half. As this was the maximum stress anticipated, it was considered satisfactory; also, an arch 20 ft in thickness was expected to be free from any tendency to buckle when under load.

For determining the refrigerating requirements of the arch, the water content of the earth to be frozen was estimated at 40 lb per cu ft, a total of 1600 tons of water. The sensible heat of the material to be frozen and the heat leakage from the surrounding slide area were considered so small in comparison with the latent heat of fusion of the water content of the earth that they were omitted from the refrigeration estimate.

The speed with which such a construction feature could be carried out was of utmost importance and, as soon as the refrigerating requirements were estimated, a search was made of the Pacific Northwest to determine what refrigerating equipment might be secured. Two ammonia compressors having a combined capacity of 80 tons of refrigeration per 24 hr were rented, and two 40-ton ammonia condensers and two 40-ton brine coolers of the shell-and-tube type were purchased. The freezing of 1600 tons of water with an 80-ton refrigerating plant was estimated to require 20 days.

The refrigerating points for freezing the earth composing the dam had to be of a type which would insure positive circulation of brine and also have sufficient mechanical strength to permit their being driven to a depth of 40 or 45 ft. The design shown in Fig. 3 was selected as best meeting these requirements. The course of the circulating brine was downward in the $1^1/_2$-in. pipe, and upward in the annular space between the $1^1/_2$-in. and 3-in. pipes. Pipe sizes of $1^1/_2$ and 3 in. were selected because they were used in large quantities throughout the project, and would have maximum salvage value.

Since the capacity of the refrigerating plant determined the time estimated for freezing the arch at 20 days, the spacing of the refrigerating points was calculated on this same time basis.

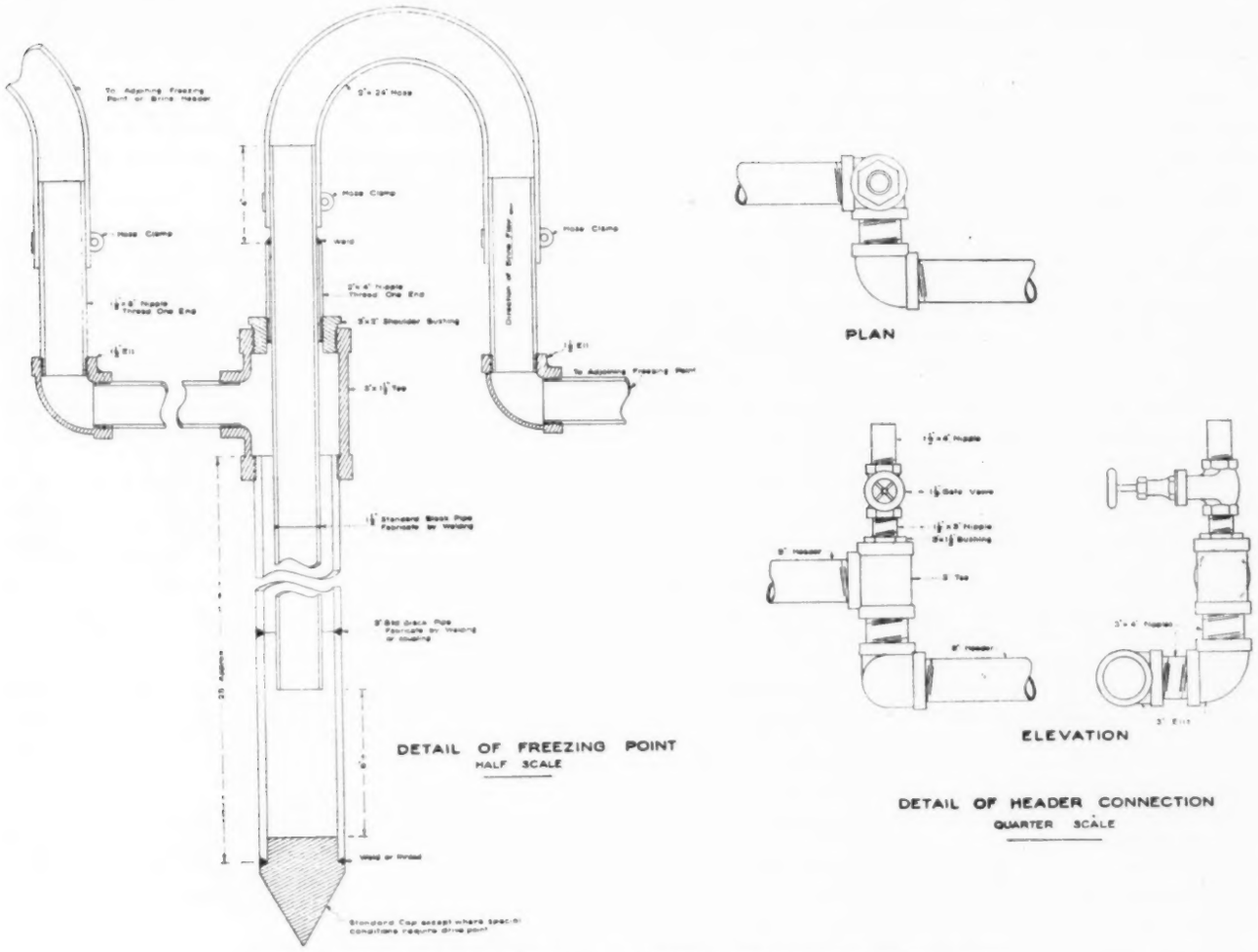


FIG. 3 DETAILS OF BRINE SYSTEM: EAST FOREBAY REFRIGERATION INSTALLATION

Although no data were available which applied directly to the time required for the freezing of earth, the following formula for the freezing of large sheets of plate ice was selected as being applicable because the thermal conductivity of ice and of a wide variety of mineral matter is almost identical.

$$\frac{21 \times t \times t}{32 - T} = \text{freezing time, hr}$$

where t = thickness of frozen material, in.
T = temperature of brine,[2] deg F

With an assumed brine temperature of 22 F and a freezing time of 20 days, the thickness of frozen earth surrounding each refrigerating point should be about 15 in. This value seemed within reason and led to the choice of 30-in. spacing between refrigerating points. The refrigerating points were installed in 8 rows with 44 points in each row. An additional 15 points were driven to form each fillet.

INSTALLATION PROCEDURE

The bedrock forming the west abutment of the frozen dam rose vertically to elevation 900 and leveled off, thus forming an ideal location for the refrigerating plant. The plant was housed in a sheet-iron building and, as the installation was in accordance with usual refrigerating practice, it need not be described except to state that the important units were in duplicate. Thermometer wells were installed in the brine lines at the inlets and outlets of the brine coolers, and in the water lines entering and leaving the condensers. Also, a float-controlled alarm bell was installed in the brine tank to give warning of a falling brine level.

By August 4, 1936, the water surface in the east excavation had been reduced to elevation 850, and unwatering was discontinued. Allowing the pool to remain at this elevation insured well-saturated earth for freezing; also the thrust of the water was expected to restrain the downward movement of the slide.

For driving refrigerating points in the slide, use was made of a gasoline-powered well-drill rig of the churn-drill type mounted on caterpillar treads. The earth at that time was so soft that the rig had to be skidded down the slide on heavy planking. A timber crib, improvised across the slide, served as footing for the rig while driving refrigerating points. Driving was done with a hammer weighing 675 lb operating with a 3-ft stroke. The hammer consisted of a section of 8-in. shafting with a guide-bar extension which fitted loosely inside the 3-in. pipes. A second driving rig, consisting of a stiffleg derrick mounted on a barge and powered with a diamond-drill rig, drove the points which could be reached from the pool.

The first points were driven on August 14. By that time the movement of the slide had decreased to a maximum of $1\frac{1}{4}$ in. in 24 hr. Small daily movements continued but were not such as to cause alarm.

The 3-in. pipes came in random lengths in excess of 21 ft,

[2] "A Lecture Course on the Principles of Refrigeration," by W. H. Motz, Nickerson & Collins Co., Chicago, Ill., 1922, lecture 11, p. 21.

and in most cases two lengths were sufficient for a refrigerating point. The first length was closed at the bottom with a standard pipe cap and was driven easily. In attaching the second length, care was taken to screw up the coupling until the pipes butted together, thus relieving the threads of transmitting the force of driving the points. A special driving coupling screwed on the upper end of each pipe protected the threads from damage by the driving hammer. The driving of points was carried on three shifts per day, and each rig averaged driving one point an hour. Because of the uniformity of the material composing the slide, no difficulty was experienced in keeping the points plumb. Following the driving rigs was a crew of pipe fitters who cut off and threaded the pipes about 6 in. above ground. The pipes were then capped and tested for tightness with air pressures at 100 psi. The leaks usually occurred at the bottom caps and were repaired by pouring quick-setting cement grout into the pipes to a depth of 18 in. In those cases where repairs were unsuccessful, the point was either pulled and redriven or a second refrigerating point was driven beside the one which was defective.

As the frozen dam was expected to be in a constant state of movement from both internal stress resulting from freezing and from external load imposed by the slide, a very flexible system of brine circuits was necessary. Flexibility between refrigerating points was secured with connections of 2-in. rubber hose; and, in the brine headers, the lengths of 3-in. pipe were connected with assemblies of three 90-deg elbows, thus permitting unlimited deflection in both horizontal and vertical planes.

The refrigerating points were connected in series in groups of 20 points each. The inlets and outlets of the groups were each connected to the brine headers through $1^1/_2$-in. gate valves. From the freezing plant, two 3-in. brine mains dropped down to the dam, where each divided into two 3-in. headers. The two supply headers lay along the center of the arch, but the return headers were near the upstream and downstream edges. The refrigerating points were so connected that the flow of brine progressed from the interior of the dam toward the warm outer surface where the brine attained its maximum temperature just before entering the return headers.

As soon as the refrigerating plant was completed, it was put in operation on the 126 refrigerating points which were ready for service. Additional points were put in operation from day to day as groups were made ready, and by September 4, all points were in service.

For the purpose of following the progress made in freezing the earth and, as a guide in determining when the unwatering of the east excavation might safely be resumed, thermometer wells of $^1/_2$-in. pipe were driven into the earth to a depth of 10 ft.

The refrigerating plant was put in operation at the height of

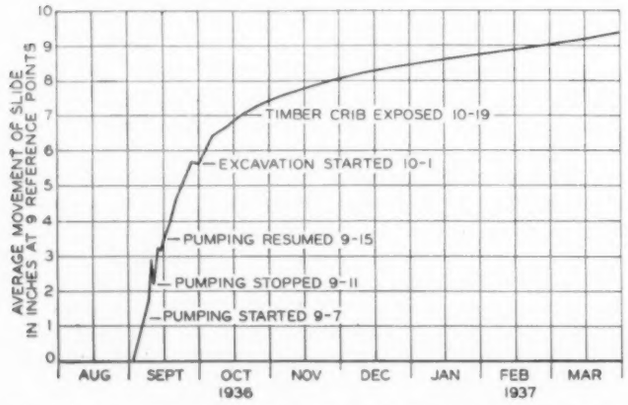


FIG. 4 AVERAGE MOVEMENT OF NINE REFERENCE POINTS ON FROZEN-EARTH DAM

midsummer temperatures, making the insulation of all refrigerated surfaces imperative. After the brine system had been put in operation and thoroughly tested, sawdust was spread to a depth of 2 ft over the area to be frozen, leaving only the loops of rubber hose exposed to the weather. Sawdust was also used to insulate the brine coolers, brine mains, and surge tank.

OPERATION OF REFRIGERATION SYSTEM

In the operation of the plant, daily readings were taken of the ammonia pressures, the brine flow, and the temperatures of the earth, brine, and condensing water. Temperatures were taken with mercury thermometers graduated in 2-deg intervals; and an attempt was made to read the temperatures to $^1/_2$ deg.

For observing the daily movement of the dam, a transit was used to measure the horizontal offsets from a base line to nine reference points equally spaced across the arch. The result of these measurements is shown in Fig. 4.

When refrigeration had been in progress 14 days, the average earth temperature within the cooled area was 33 F, and the unwatering of the east excavation was started. In 4 days the water level in the pool was lowered 8 ft. During the last 24 hours of this period, a 2-in. movement of the dam occurred, and unwatering was discontinued. At the end of an additional 4 days, the earth temperature had dropped to 30 F, and unwatering was resumed and carried to completion.

As excavation proceeded, the clay in the pit subsided, leaving the downstream face of the frozen dam exposed to the atmosphere. To conserve refrigeration and reduce the sloughing away of the face of the dam, tarpaulins were hung so as to form a continuous curtain across the vertical face of the arch. By the middle of November, the weather became cool enough so that more refrigeration would be gained from the atmosphere than would be lost to it, so the canvas was removed. With the coming of warm weather in the spring, the canvas was reinstalled.

The location of the frozen dam was so close to the area of excavation that precautions were taken to reduce the damage from rocks hurled in blasting operations. That part of the refrigerating system containing ammonia was adequately protected by the shed in which it was housed, but the loops of brine hose connecting the refrigerating points on the dam were unprotected. To minimize the loss of brine in case any hoses were cut by flying rocks, the freezing plant was shut down a few minutes before blasting and the main valves on the supply and return headers were closed. In case a hose was injured, the section of points containing the injury was closed off until it could be repaired, but the remainder of the system was restored to operation immediately. During the 2 months in which blasting operations were within range of the frozen dam, eight loops of hose and one pipe nipple were broken.

Since the frozen arch was expected to be in a state of more or less constant movement as it yielded under its load of earth, the development of leaks in the refrigerating points was anticipated from the beginning of the design. The freezing plant had been in operation about 3 weeks when the first underground leak occurred in a refrigerating point. Additional leaks occurred from time to time and they were located by pinching the rubber hoses tight with wooden clamps. Any hose which became deflated indicated a leak in the refrigerating point to which it was attached. The leaking point was removed from service by splicing hoses around it. The brine which escaped within the dam was never observed to have any injurious effect upon the frozen earth, and, as all brine leaks were assumed to be deep in the earth, no attempt was made to repair them.

During the first 30 days the refrigerating plant was in use, both compressors were operated continuously. By that time,

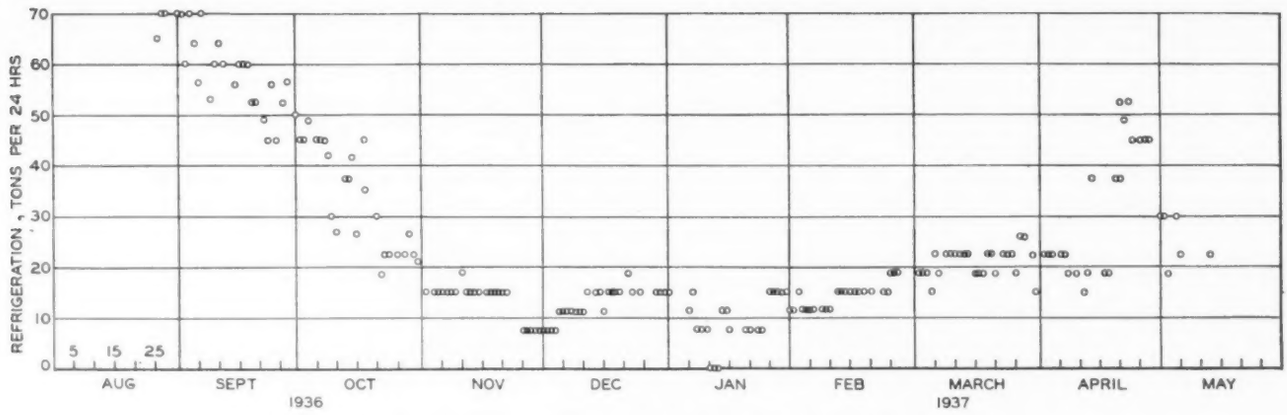


FIG. 5 REFRIGERATING LOAD, TONS PER 24 HR ON FROZEN-EARTH DAM

the earth was quite well frozen, and the principal load consisted only of heat leakage. During the next 30 days, both compressors were operated during the day, but only one was operated at night. Only one compressor was operated for the remainder of the winter, and it was shut down during a few days of subzero weather.

In the course of excavation on the east side of the river, the contractor built below the frozen dam a concrete sump from which all waste water was pumped to the river through a 10-in. line up the east forebay slope. This sump remained in use until the concrete in the dam had attained such height that the frozen-earth dam was no longer needed. As preparations were being made for backfilling the space between the frozen dam and the Coulee Dam, the sump pumps were transferred to a higher elevation, and the water in the sump was allowed to rise, flooding the space between the dams to elevation 827. The water at this elevation was very turbulent, thawing the frozen earth and undermining the arch to a depth of 4 ft across its entire face.

As a consequence, the refrigerating load was so much increased that both compressors had to be operated continuously. On the completion of the backfill, the water in the sump was excluded from the face of the frozen dam, and the refrigerating load decreased almost to normal. The sudden increase in refrigerating load at that time is shown in Fig. 5 beginning about April 20.

SALVAGE OPERATIONS

When the concrete in the Grand Coulee Dam reached a height which was above danger from earth slides, the dismantling of the refrigerating system was started. The system of brine headers and freezing points consisted of about 16,000 ft of $1^1/_2$-in. and 17,000 ft of 3-in. standard black pipe. For thawing the refrigerating points loose in the earth, steam was obtained from a near-by derrick. Steam hoses were inserted in the $1^1/_2$-in. inner pipes and pushed to the bottom. The hoses were securely tied in place and steam at full boiler pressure was turned on. In 15 or 20 minutes a point would be ready to pull. By using four thawing hoses, it was possible to keep ahead of a crawler-type crane which pulled a maximum of 13 points an hour.

In the process of thawing, many of the pipes were fractured at the coupling, but they usually held together so that the entire point could be recovered. The breaking of pipes during thawing could be avoided by inserting the steam hose in the $1^1/_2$-in. pipe very slowly and thawing the pipe loose progressively from the top, but as speed was imperative and the breaking of pipe was not important so long as it could be recovered, this thawing procedure was not used.

TECHNICAL DATA

Although the construction of the frozen-earth dam was but a small feature of a large construction project, it was thought to present an unusual application of refrigeration, and that such data as could be secured might be of future value.

Earth Pressure. About 50 ft upstream from the frozen-earth dam, a drainage well was dug to a depth of 60 ft for the purpose of relieving hydrostatic pressure against the dam. This was known as the E-5 well. It was 6 ft × 9 ft 3 in. in section, and was cribbed with fir planking having a net thickness of $2^7/_8$ in. By measuring the deflection of the timber cribbing, it was possible to calculate roughly the surrounding earth pressures, and obtain some idea of the force being resisted by the frozen arch. The planks comprising the cribbing were treated as simple beams supported at the ends. The uniformly distributed loads were calculated from the observed deflections. As the cribbing had been in place about one month and had be-

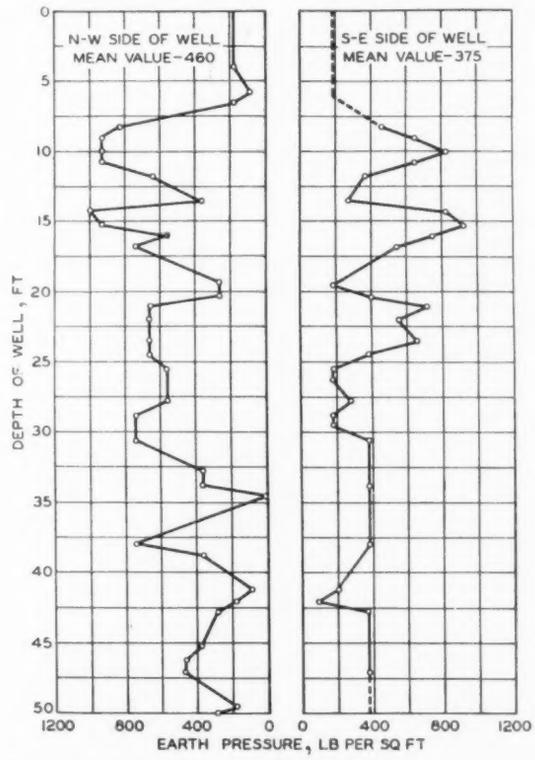


FIG. 6 EARTH PRESSURE IN E-5 WELL DETERMINED FROM DEFLECTION OF CRIBBING

come thoroughly water-soaked, an assumed modulus of elasticity of 1,000,000 was used in the calculations.

The values obtained are shown in Fig. 6, and are practically the reverse of what might be expected, the greater pressure being at the top instead of at the bottom of the well. If the pressures on opposite sides of the well were not in fair agreement, one might seriously question the data indicating this unusual situation. An explanation offered is that the material near the top of the well had been disturbed during the slide more than that at lower elevations. This explanation is confirmed by earth pressures observed in the E-4 well located 300 ft further upstream. The E-4 well was dug in firm, undisturbed earth, and the pressures throughout its entire depth were very uniform, and were in close agreement with those obtained in the bottom of the E-5 well. However, the material at the site of the frozen dam was known to have been thoroughly disturbed, as it was carried down by the slide, and it is possible that the ratio of pressure with respect to depth found near the top of the E-5 well also prevailed for the entire depth of the frozen arch.

The material composing the slide was found to weigh 117 lb per cu ft. Since, at a depth of 15 ft, the earth pressure in the well was 1000 lb per sq ft, the hydrostatic pressure of the earth was but 56.5 per cent of that possible by treating the earth as a fluid. Should this condition have prevailed against the frozen arch, the pressure at a depth of 40 ft would have been 2650 lb per sq ft.

The following tabulation compares the earth pressures observed in the E-5 well with those which might possibly have been exerted against the frozen arch, and with those assumed initially in the design of the dam:

	Earth pressures	
	Maximum, lb per sq ft	Average, lb per sq ft
E-5 well, northwest side	1000	460
E-5 well, southeast side	920	375
Estimated possible	2650	1325
Assumed initially	2700	1350

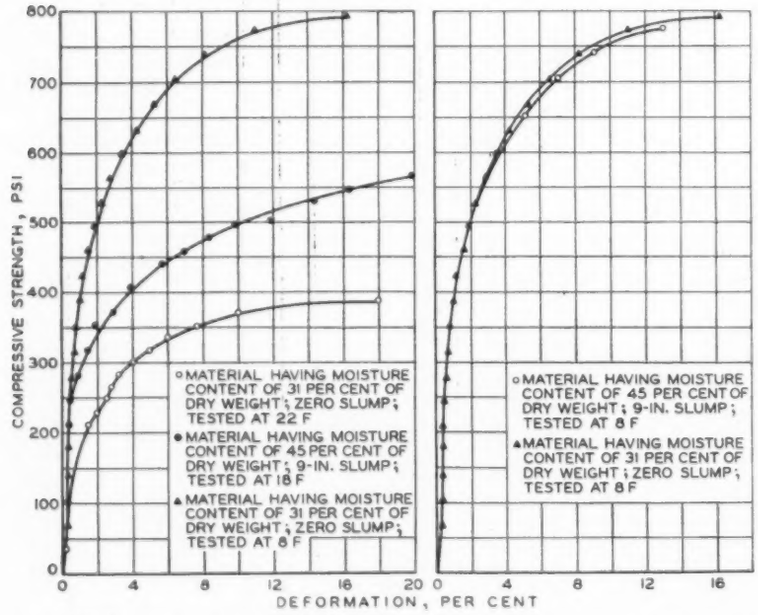

COMPRESSIVE STRENGTH, PSI
DEFORMATION, PER CENT
○ MATERIAL HAVING MOISTURE CONTENT OF 31 PER CENT OF DRY WEIGHT; ZERO SLUMP; TESTED AT 22 F
● MATERIAL HAVING MOISTURE CONTENT OF 45 PER CENT OF DRY WEIGHT; 9-IN. SLUMP; TESTED AT 18 F
▲ MATERIAL HAVING MOISTURE CONTENT OF 31 PER CENT OF DRY WEIGHT; ZERO SLUMP; TESTED AT 8 F
○ MATERIAL HAVING MOISTURE CONTENT OF 45 PER CENT OF DRY WEIGHT; 9-IN. SLUMP; TESTED AT 8 F
▲ MATERIAL HAVING MOISTURE CONTENT OF 31 PER CENT OF DRY WEIGHT; ZERO SLUMP; TESTED AT 8 F

FIG. 7 (*left*) TESTS ON ULTRAFINE MATERIAL SHOWING INCREASE IN STRENGTH AT LOWER TEMPERATURES

FIG. 8 (*right*) COMPARISON OF MATERIALS OF SAME TYPE BUT VARYING MOISTURE CONTENT, AT SAME TEMPERATURE, SHOW ALMOST IDENTICAL STRENGTHS

Compressive Strength. As the design of the frozen dam was undertaken without any definite information concerning the structural strength of frozen earth, an effort was made during the operation of the freezing plant to collect such data experimentally. Earth having various degrees of moisture was placed in 6 × 12-in. molds for concrete test cylinders, and was frozen in the brine surge tank. The frozen specimens were quickly taken to the concrete-testing laboratory, and tested for compressive strength before they had time to become warm. As the laboratory was not refrigerated, it is quite possible that the maximum stress values were not obtained. Also, it was impossible to determine the rate of creep of the various materials under given stresses. With but one exception, each specimen failed through plastic flow, without any definite yield point being perceptible.

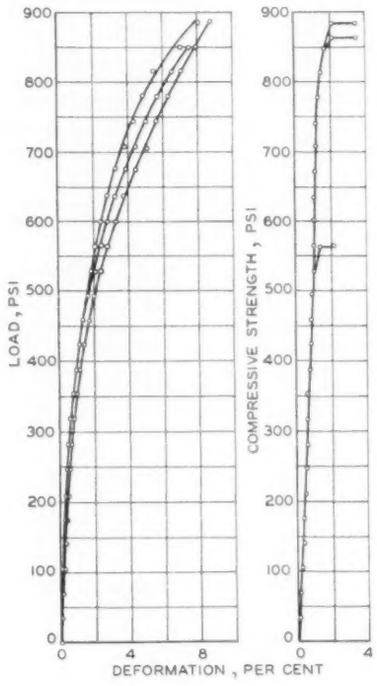


FIG. 9 (*left*) FROZEN QUICKSAND FROM E-5 WELL

(Moisture 42.7 per cent of dry weight; temperature 8 F; slump 9 in.)

FIG. 10 (*right*) FROZEN PIT-RUN GRAVEL PLUS WATER TO FILL VOIDS

(Temperature 8 F.)

The curves in Fig. 7 represent tests run on ultrafine material from the slide, and indicate that an increase in strength results from lower temperatures. Fig. 8 represents materials of the same type but with moisture contents of 31 and 45 per cent of the dry weight, and show practically identical strengths at the same temperatures, thus indicating that the variation in moisture did not greatly influence the strength. The curves in Fig. 9 show the results of freezing quicksand. This material gave the highest strength obtained. As the moisture content and temperature of freezing were the same as in Fig. 8, the increase in strength was thought to have resulted from the larger dimensions of the sand particles. To determine the effect of an additional increase in the size of parti-

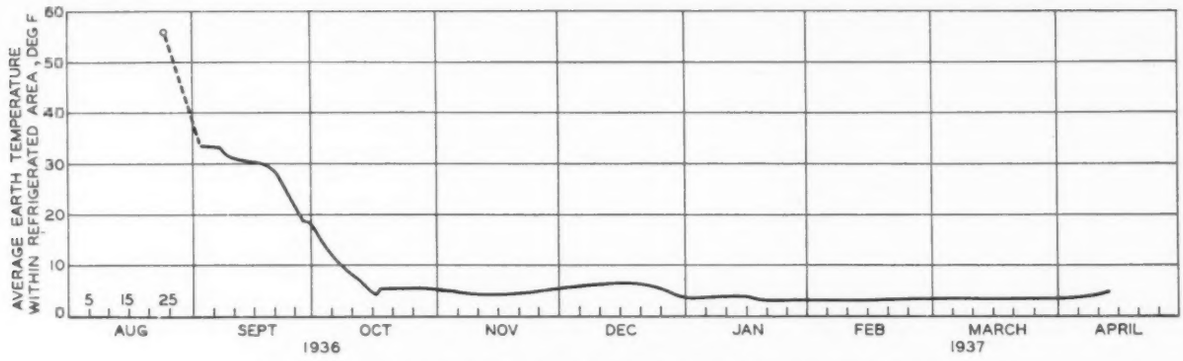


FIG. 11 AVERAGE EARTH TEMPERATURE WITHIN REFRIGERATED AREA

cles, the test shown in Fig. 10 was conducted with pit-run gravel. This test was exceptional in that it had a definite yield point, which resulted in the sudden failure of the specimens.

Failure apparently resulted from the shattering of the matrix of ice which bound the gravel particles together, and had the appearance of plastic flow, with the exception that it occurred suddenly. The development of shear planes was not apparent. An additional test was run to determine the strength of ice, but the capping of the specimens evidently was defective because each one shattered into vertical columns at a stress of about 400 psi.

The foregoing curves indicate quite definitely the effect of temperature on the strength, but the number of experiments was not sufficient to give much information on the effect of variations in moisture content and in the size of earth particles.

Earth Temperatures. For observing the earth temperatures within and adjoining the refrigerated area, twenty-five thermometer wells were driven into the slide to a depth of 10 ft. Daily readings were taken with mercury thermometers graduated in 2-deg intervals. Fig. 11 shows the average of all temperatures within the refrigerated area. The exact shape of the curve, prior to September 2, can only be approximated because the thermometer wells had not been installed. The most important part of the curve is the flat portion extending from September 2 to 19, and indicating the period in which the actual freezing of the earth occurred.

The curves in Fig. 12 show earth temperatures between refrigerating points diagonally across a square. The unexpected result in this case was the fact that the earth cooled and became frozen uniformly across the entire area instead of freezing progressively outward from the refrigerating points. However, the total freezing time was in excellent agreement with the calculations, which were based on the freezing time of plate ice.

Refrigerating Load. In Fig. 5 is shown the daily values of the refrigerating load, calculated in tons of refrigeration per 24 hr. These values show that, during the first 2 months of operation, the load decreased at approximately a uniform rate. During the first month, both compressors were operated continuously, and the decrease in load resulted from the insulating effect of the frozen earth which surrounded the refrigerating points. The continued decrease in load resulted from operating the plant at reduced capacity to avoid freezing the brine. There is no irregularity in the load curve, which corresponds to the flat portion of the earth-temperature curve and indicates the period in which occurred the freezing of the earth. By November 1, the dam had been completely frozen and cooled, and the refrigerating load consisted only of heat leakage from the surrounding earth. The leakage remained quite constant throughout the winter and increased slightly with the coming of warmer weather in March, and the first weeks of April. The sudden increase in load about April 20 resulted when the face of the dam was undermined by water which was allowed to accumulate in a sump below the dam. Backfilling the sump with earth excluded the water from the face of the dam, and caused the refrigerating load to return to normal, as shown for the month of May.

Movement of Dam. For observing the daily movement of the dam, a transit was used to measure the horizontal offsets from a base line to nine refrigerating points selected for reference. Fig. 4 shows the average movement of all reference points. A comparison of this curve with Fig. 11 shows that, as the temperatures became lowered, the rate of earth movement was greatly decreased although excavation below the dam removed all support from the lower side. The average movement

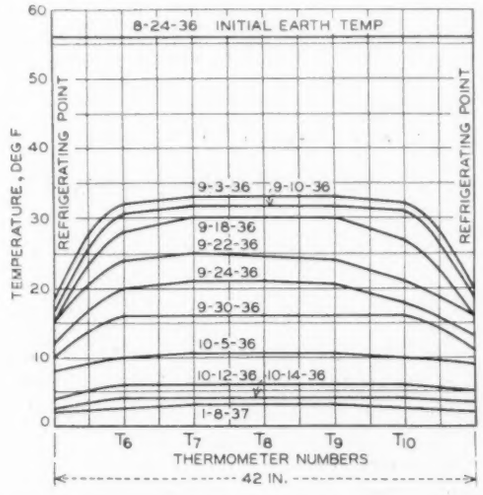
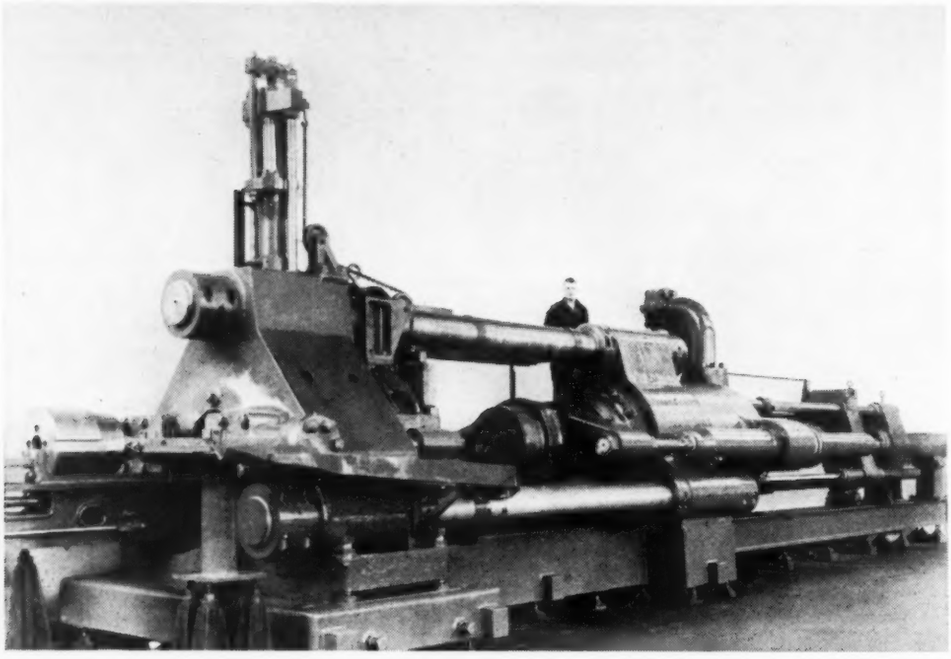


FIG. 12 EARTH TEMPERATURES BETWEEN REFRIGERATING POINTS WITHIN A GIVEN REFRIGERATED AREA

of the dam reached a maximum of 9 in. When one considers that glaciers have been observed to flow several feet per year, it is remarkable that this small barrier of frozen earth had so small a displacement during the eight and one half months it was in use.

Financial Aspects. The frozen dam was constructed under an extra-work order issued to the Mason-Walsh-Atkinson-Kier Company, and payment was made on the basis of cost plus 10 per cent. The following items are listed for the purpose of comparing the cost of refrigeration with the cost of construction methods commonly used in the control of slides. These items

(*Continued on page 36*)



MODERN 2200-TON METAL EXTRUSION PRESS FOR PRODUCING TUBES, RODS, AND PROFILES

Recent Developments in METAL EXTRUSION

Stainless Steels, Nickel Alloys, Bearing Steel, and Nonferrous Alloys Now Being Extruded Into Tubing, Rods, and Profiles

By ALBERT B. CUDEBEC

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WHILE the extrusion of nonferrous metals into rods and simple profiles has been a commercial success for 35 years, it is only during the last five years that the art has made its greatest contribution to industrial progress by the production of stainless-steel, nickel-alloy, and bearing-steel tubing, shapes, and rods. Moreover, manufacturing costs have also been materially reduced over the older methods. This advance, which appears likely to open new fields for several special ferrous alloys, has been made possible, not by any new and startling inventions, but rather by a ceaseless research in metallurgy and a step-by-step improvement in the design of the hydraulic extrusion press.

The first commercial production of ferrous alloy tubing by extrusion was stainless steel (18-8), but this was quickly followed by other stainless alloys known as 17 chrome and 12 chrome. Research and trials to produce monel-metal tubing were also undertaken by the nickel producers. Mond-metal tubing, as well as numerous other articles of nickel alloys is now a full-fledged industry. Furthermore, exclusive trials were recently made upon a fairly large scale upon bearing steel (52-100), and the results give clear indications that even this difficult alloy will eventually be extruded commercially into tubing.

The designers of metal-extrusion machinery have concentrated their recent efforts particularly in the field of stainless steels and other special ferrous and nonferrous alloys which do not work well by rolling, welding, or piercing but which now can be economically extruded. Several such alloys are being extruded in large quantities in Great Britain but have not yet been commercialized in the United States.

The advantages of extrusion for many alloys over rolling and drawing are not as yet widely known. It would appear true to state that any metal which has been extruded from a cast billet has, by this process, acquired a grain structure more free from faults than if it had been rolled. This change in structure is probably due to the fact that extrusion is a squeezing-compression process, while piercing, rolling, and drawing are stretching operations. Moreover, there are some special alloys which cannot be successfully rolled at all without developing

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serious inherent faults, which render them unfit for certain commercial purposes.

The extrusion process does not compete in the ordinary field of carbon steel and is only economically interesting in handling expensive ferrous alloys and all nonferrous products. This field, however, is very wide as special alloys are now being substituted for heavier parts in almost every branch of mechanical-engineering design.

Production costs for stainless steel tubing, taken from extensive British sources, and adjusted upward to meet American labor and material costs, clearly indicate that beginning with the cold billet, the cost in America per ton of producing stainless-steel tubing, ranging from $2^1/_2$ in. to $3^1/_2$ in. outside diameter, with normal commercial thickness of walls, will run around $27 per ton. These costs include plant amortization, taxes, fuel, oil, and overhead. An additional advantage of prime interest is the fact that extruded tubing can be drawn to smaller sizes at a lower cost than tubes produced by piercing or other processes.

METAL EXTRUSION NOT EXACT ART

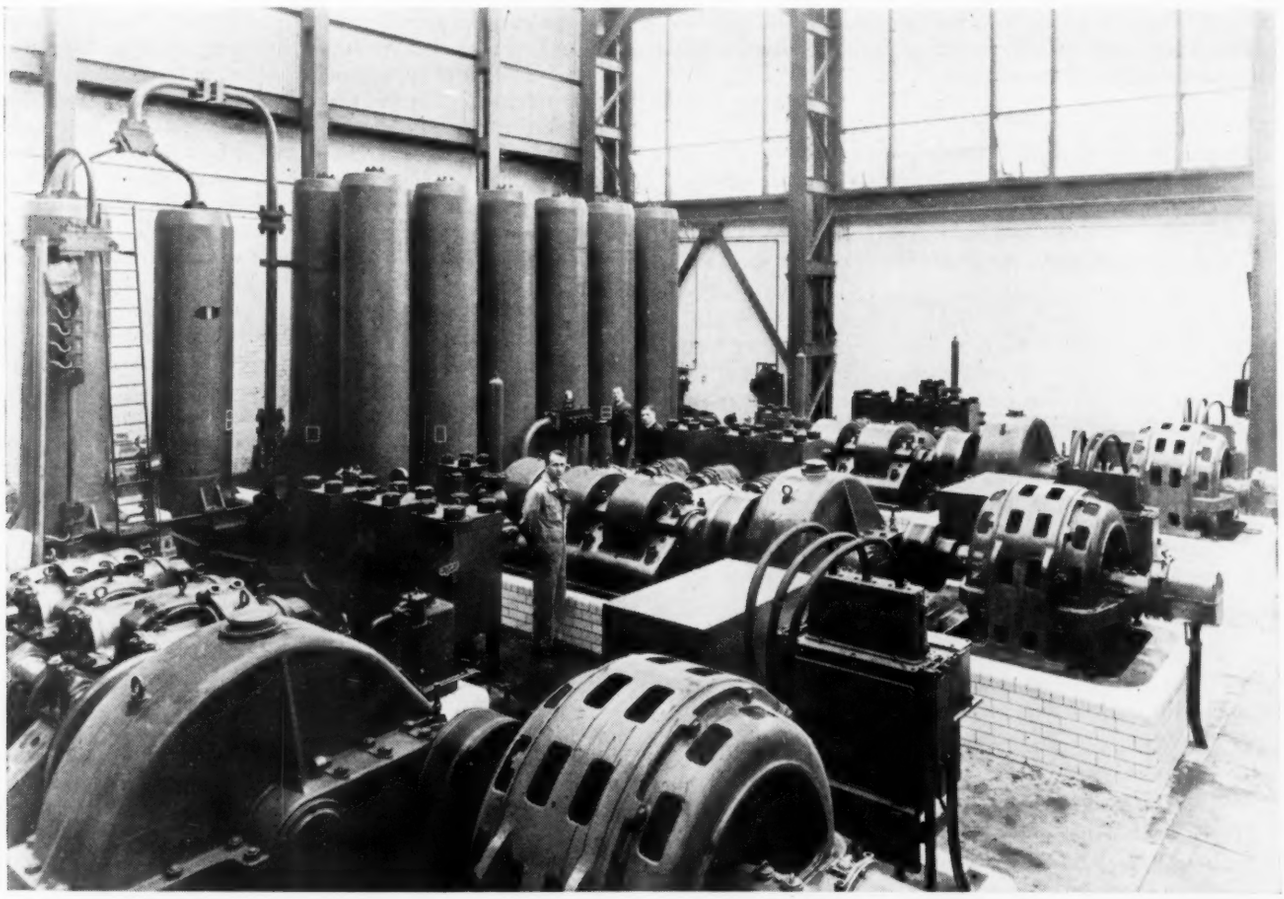
Metal extrusion is not yet an exact art because there are so many variables, particularly in handling the special alloys. Each alloy appears to have its own particular extrusion temperature band, which ranges from 800 to 900 F for pure aluminum, up to around 2200 and 2300 F for cupronickels, bearing steels, and stainless steels. To obtain first-class extruded products, some of the alloys must be held to a range of only 20 F (and even less) temperature variation during the extrusion process.

Other variables include troubles which arise from heating billets either too rapidly or too slowly, and the speed with which the extrusion must be made. If the extrusion is too rapid, the metal may tear, while if too slow or the billet is too cold, the billet may stick to the container wall.

RECENT INCREASE IN PLANT CAPACITIES

Research in press design and in metallurgy has recently been rewarded by the successful production of much larger presses than formerly existed. These advances have received the additional impetus of British national-defense requirements, and have caused the construction of presses for use in England and France up to 6600-ton capacities. These presses are equipped with containers 48 in. long with a diameter of 20 in. and operate at 4500 psi hydraulic pressure. These large-capacity presses are required for handling aluminum and magnesium alloys, which are so vitally necessary to modern aircraft production.

Perhaps 50 per cent of the extruded products are finished profiles which only require straightening and in some cases heat-treatment before being completed. The remaining 50 per cent of the production is extruded into round bars, strips, and other half-finished products. This latter material constitutes raw material for the subsequent processes of forming into thin strips and other articles, mostly by cold rolling. The reason why it is desirable first to extrude this raw material is because these light metals thereby acquire malleability and still retain their normal



LARGE PISTONLESS AIR-HYDRAULIC ACCUMULATOR FOR OPERATING SEVERAL HYDRAULIC PRESSES AT THE SAME TIME, ERECTED IN 1939 IN ONE OF GREAT BRITAIN'S LATEST STEEL MILLS

[The accumulator includes three high-pressure pumps (three-throw), 220-gpm, 550-hp motors, speed of crankshaft 120 rpm; total capacity of pressure vessels (air and water) 2900 gal, operating pressure, 300 atm, approximately 4300 psi.]

tensile strength and uniform grain structure in their finished state.

Soon after the British defense program got well under way, the metal-extrusion process quickly became so vital to national-defense purposes that 40 or 50 of these large plants are now in production in Great Britain. Moreover, several plants for the British commonwealths are either in production or are now being rushed to completion.

It is not definitely known how many of these plants were in operation in France before its recent collapse, or how many are in use in Greater Germany, but it is probable that several dozen of them are now operating upon a 24-hr basis. From these figures, one can visualize the probable expansion in extrusion plants which may occur in the United States before our present national-defense program is completed.

TECHNICAL FEATURES

It is doubtful that the large modern tube extrusion press ranging from 4000-ton to 6600-ton capacity would ever have been developed if it had not been for the pistonless air-hydraulic accumulator with which it is driven. The older type of weighted accumulator would have presented almost insuperable obstacles against obtaining a satisfactory control, which is so essential in operating a large modern press. It is believed that the largest pistonless hydraulic accumulator which has as yet been put into regular production is located in one of the new industrial plants in Great Britain, which went into production at the end of 1939. It has a useful water capacity of 2900 gal operating at 3150 psi, and supplies hydraulic pressure for operating not only the largest drawing press in the world but also a 5000-ton piercing press and other hydraulic equipment located at different points in a modern steel plant.

HORIZONTAL- VS. VERTICAL-TYPE EXTRUSION PRESSES

Modern extrusion-press designs are either of vertical or horizontal types. Most of the modern presses are the horizontal type, although some production managers still prefer the vertical design.

The disadvantages of the vertical type are:

(1) It is limited to smaller capacities (rarely above 1000-ton ram pressure), because large-capacity presses would require excessive headroom above the mill floor, and the deep pit under such a press might present serious obstacles.

(2) The press operator cannot readily observe the extruded pieces as they emerge from the dies upon the runout trough.

(3) The extruded pieces must necessarily be limited in length, because they must flow downward into the pit and must then be bent while still hot before being removed from the pit.

The advantages of the vertical type are:

(1) It is claimed that the operation is more rapid (more pushes per hour).

(2) There is less delay in changing dies between pushes.

(3) Some manufacturers also claim that extruded tubes from vertical presses will average more concentric than those produced by the horizontal type.

The disadvantage of the horizontal type is that more floor space is required than is necessary for the vertical type.

The advantages of the horizontal type are:

(1) There is no practical limit of press capacity providing there is sufficient horizontal floor space.

(2) Press operator can personally observe the extruded pieces as they emerge.

(3) The cutoff device for removing the butts of the billets from the extruded pieces (either by shearing device or by metal saw) can be much more easily provided and operated.

(4) It is also probable that the modern method of press suspension upon the foundations of the horizontal type largely eliminates variation in tube-wall thickness arising from expansion and contraction in the press, and now makes it possible to produce tubing with concentric accuracy equal to that of tubes produced by vertical-type presses.

SURFACE OXIDATION

Surface scale caused by oxidation has for years been one of the tough problems to be solved since metal extrusion first came into practice. Some manufacturers still follow the method of scalping the surface of the billets before extrusion. Most manufacturers, however, now extrude the billets without scalping and leave a thin skin shell in the container after the extrusion cycle is completed. This shell is quickly and economically removed by pushing a tight-fitting dummy block through the container immediately after the extrusion is completed. This process takes only a few seconds between pushes, and the extruded products are found to be as completely free from oxidation as though the billets had been previously scalped.

SCRAP LOSSES

The butt ends of billets cannot be entirely extruded, whether billets are ferrous or nonferrous. These butt ends must be cut off from the extruded piece, either by a shearing device or by a metal saw. The amount of scrap loss in this butt end depends upon whether tubes or rods and profiles are being extruded. In modern presses, the amount of scrap, which includes the butt end and the aforementioned shell, now ranges from 8 to 10 per cent for tubes, and from 10 to 12 per cent for rods and profiles.

Extruded alloys are expensive and scrap metal must be kept at a minimum, hence every possible method of reducing scrap loss is carefully sought.

The American production manager, however, is notable for his versatility and ingenuity and for this reason new high production records in extruded metal are constantly being achieved. Moreover, new articles are now constantly being extruded, which in turn is opening up many new commercial fields.

TOOLS

The wear upon dies and other tools is one of the most important items to be considered in operating a metal-extrusion plant. Most of the extrusion tools were formerly imported into America from Czechoslovakia or from Germany, but as the domestic demand increased, American tool suppliers began to furnish better and better tools. This proved to be a great help as, since the outbreak of the present European war, all extrusion tools are now produced in the United States of qualities which appear equal to any which have ever been imported.

SIZE RANGES OF EXTRUDED TUBING

Tubing can be commercially extruded in sizes from a minimum of $1^1/_4$ in. to 4 or 5 in. outside diameter, depending upon the capacity of the press. However, experience has shown that 75 or 80 per cent of the commercial demand for alloy tubing is for sizes below 3 in. diam. In order to provide a maximum tonnage, tube-extrusion presses are usually operated to produce as few different diameters as possible, always of the upper range sizes. These tubes, known as "blanks," are then cold drawn to the smaller sizes. There is no practical upper limit to the wall thickness which can be economically extruded, but the minimum wall which can be extruded for most alloys is about 0.16 in. It is cheaper, however, to draw down from thicker walls than to extrude directly to this minimum dimension, as the wear upon dies increases rapidly with the thinner walls.

SOLVING PIPE PROBLEMS

A Mechanical Method for Cases Involving Temperature Expansion

By FRED M. HILL

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WITH the general adoption of higher pressures and temperatures in central-steam-plant designs within the last few years came the need for more accurate and reliable methods of solving problems involving stresses and reactions caused by temperature expansions.

Mathematical methods brought forth to meet this need, although most helpful, were found to be laborious and complex in application, especially when applied to pipe runs having branch connections, diagonal sections, variable radii and degrees of curvature in bends, and restraining attachments.

DEVELOPMENT OF MECHANICAL METHOD

The mechanical method herein described was developed by the author to facilitate the solution of such problems by the use of models. Early experiments indicated that reliable results could be obtained by employing small, solid, die-drawn steel rods on the order of $^1/_4$ in. in diameter. They were found to possess advantages in being easy to handle and form to shape and in yielding readily measurable deflections with the application of small loadings. Another advantage was the possible exaggeration of deflections to the extent that one might easily observe the effect of various changes in, or the relative importance of, the applied loadings. In this respect the testing device may be thought of as an analyzer. Although the rods do not simulate the prototypic pipe with respect to the flattening or ovalization occurring within the bends, the close agreement between model and mathematical answers appears to justify their adoption.

Consideration was given to the use of tubing with its theoretical advantage of closer simulation, but the practical advantages of rods were decided to be of greater importance.

The method is not thought to possess time-saving advantages over mathematical methods for simple pipe runs in one plane having no more than two or possibly three 90-deg bends when only the end reactions are sought.

DESCRIPTION OF TESTING DEVICE

A framework *A* in Fig. 1 made of welded steel forms a structure for attaching one end of the model shown at *B*, adjustable ball-bearing pulleys, one of which is shown at *C*, and the micrometer measuring heads *D* and *E*. Head *E* is used for branch runs and for measuring deflections and rotations of intermediate points along the run. To the free end of the model is attached an assembly of three moment arms which extend in the three usual coordinate directions of *X*, *Y*, and *Z*. These are shown more clearly as *F* in Fig. 2 of the same setup. Fig. 3 shows the micrometer head *D* carrying ring *G* which has four adjustable needle points *H* attached thereto. To the end of the model is fastened the hub *I* to which the moment arms are attached and the four needles *J*. A counterbalance, not shown, supports the weight of the moment arm assembly to prevent undue sagging of the model.

Prior to applying loadings on the moment arms the points of the needles on the ring and those on the moment arm assembly are brought into alignment by movements of the micrometers in the head *D* and of the double-ball universal joint *K*. In this position the graduated micrometer sleeves *L* are set at zero.

Some convenient proportional or scale part of the pipe expansions in the three coordinate directions is now set off on each of the three micrometers of the measuring head *D*. Forces consisting of suspended weights attached to lines are next applied either directly or with the use of the pulleys to each of the moment arms at such points and in amounts, determined by trial, that alignment in all directions is again indicated by the system of needles. The free end of the model having thus been deflected now simulates the given position of the prototype in its heated condition.

Axial alignment of the needle points can be duplicated by several different operators without difficulty with the unaided eye within three to five thousandths of an inch, a relatively small percentage of the selected model deflections. Although the endwise clearance between the needles is small as will be noted in Fig. 3, no difficulty is experienced with their interference during manipulation because the points merely glide past each other without injury.

The method of finally determining the accuracy of alignment of the applied forces in the three coordinate directions consists of sighting across the attached lines to straight edges temporarily fastened to or laid on the framework. The downward force naturally aligns itself by hanging plumb.

CONVERSION OF MODEL REACTIONS

By applying the principles of similitude to beam-deflection formulas used in pipe calculations the following conversion formulas are obtained which apply to the extremities as well as to intermediate points. Because of space requirements the derivation of these formulas is omitted in this paper. A good reference on this subject, however, is given in the bibliography (1).[1] For forces

$$\frac{F_p}{F_m} = \frac{E_p}{E_m} \times \frac{I_p}{I_m} \times \frac{\Delta_p}{\Delta_m} \times S^3 \quad \ldots\ldots\ldots\ldots [1]$$

For moments

$$\frac{M_p}{M_m} = \frac{E_p}{E_m} \times \frac{I_p}{I_m} \times \frac{\Delta_p}{\Delta_m} \times S^2 \quad \ldots\ldots\ldots\ldots [2]$$

in which

F = applied load, lb
E = modulus of elasticity, psi
I = moment of inertia, in.^{4}
Δ = deflection, in.
S = ratio of lengths of model to pipe
M = moment, in-lb
p = subscript indicating pipe
m = subscript indicating model.

These equations hold true irrespective of the geometrical

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[1] Numbers in parentheses refer to Bibliography at end of paper.

shape of the run and whether branches or restraints are attached. It is apparent that the model need not be held at the same temperature as the prototype, because the modulus of elasticity of the pipe at its operating temperature forms a simple ratio with the modulus of elasticity of the model at room temperature. For this reason brass or any other convenient material may be used. The successful use of brass rods in simulating steel structures has been reported (2). Disregarding the flattening factor, as in the use of solid rods, any convenient scale of moments of inertia may be employed. Any scale of deflections within the elastic limit of the rods may be used as long as the geometrical relations of model to prototype are not appreciably disturbed. Advantage is taken in this method of the fact that a large scale of deflections may be used by choosing deflections of sufficient magnitude to give a relatively small error in measuring.

COMPARISONS OF MODEL WITH MATHEMATICAL ANSWERS

The chief limitation in determining the accuracy of pipe-problem answers is the lack of field data with which to make comparisons. Setups in the field for securing the desired data are most difficult to make. Comparisons of model with mathematical answers in this paper are made with the latter as basic in the figuring of percentages of deviation except as noted in Table 6. In considering the magnitude of the deviations being reported it seems pertinent to mention in connection with three-dimensional runs that deviations reported by others between theoretical formulas and results of tests on full-sized bends when a force is applied at right angles to the plane of the bend vary from 10 to 50 per cent (3).

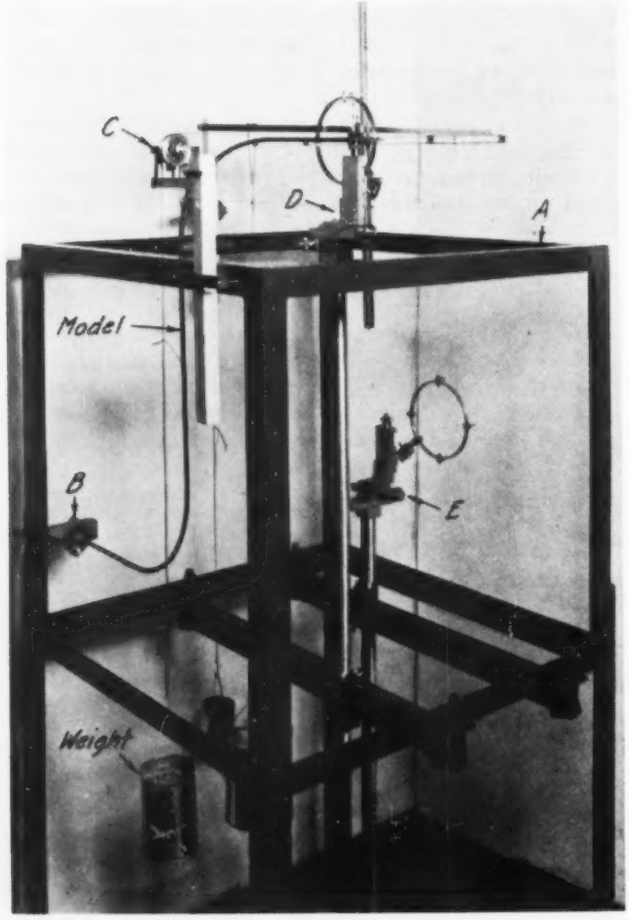

FIG. 1 MODEL SETUP OF TYPICAL THREE-DIMENSIONAL PIPE RUN (Answers in Table 1.)

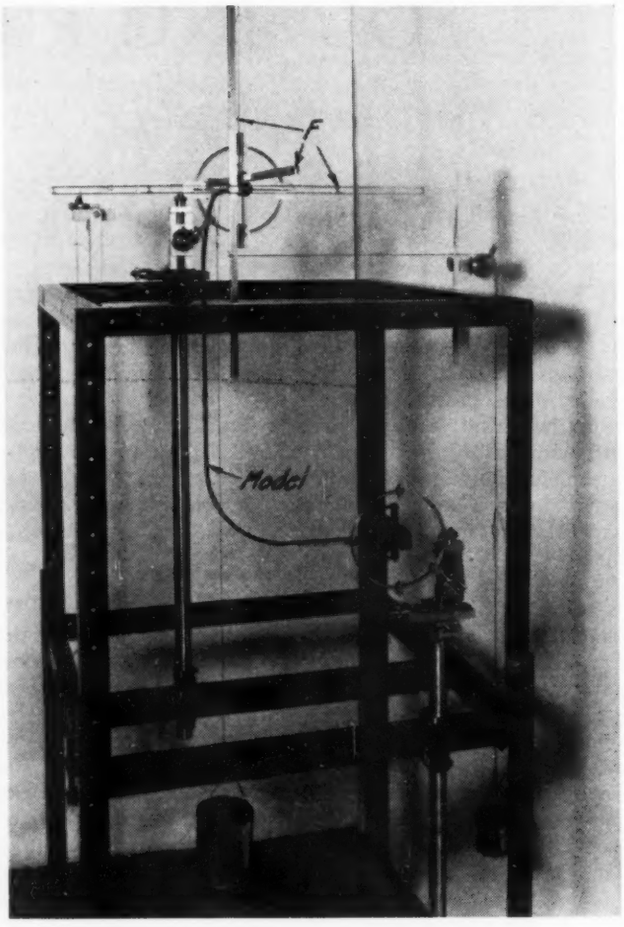

FIG. 2 OPPOSITE VIEW OF SETUP SHOWN IN FIG. 1

TABLE 1 THREE-DIMENSIONAL PIPE RUN ILLUSTRATED IN "PIPING HANDBOOK" (4)

(Forces are given in pounds and moments in inch-pounds)

End reactions	Mathematical	Model	Difference	Difference, per cent
Force F_X	5,010	5,510	500	+9.98
Force F_Y	20,870	21,610	740	+3.55
Force F_Z	3,855	4,019	164	+4.25
Moment M_{ZY}	220,652	270,000	49,348	+22.36
Moment M_{XY}	1,786,070	1,727,000	59,070	—3.31
Moment M_{XZ}	381,548	350,000	31,548	—8.27
			Average deviation	8.62

Table 1 shows a comparison of answers obtained from the model with the mathematical answers given for the problem

TABLE 2 THREE-DIMENSIONAL PIPE RUN ILLUSTRATED IN "PIPING HANDBOOK" (4), FLATTENING FACTOR OMITTED

(Forces are given in pounds and moments in inch-pounds)

End reactions	Mathematical	Model	Difference	Difference, per cent
Force F_X	8,009	5,510	2,499	—31.20
Force F_Y	30,918	21,610	9,308	—30.11
Force F_Z	5,647	4,019	1,628	—28.82
Moment M_{ZY}	247,249	270,000	22,751	+9.20
Moment M_{XY}	2,455,969	1,727,000	728,969	—29.68
Moment M_{XZ}	556,663	350,000	206,663	—37.12
			Average deviation	27.69

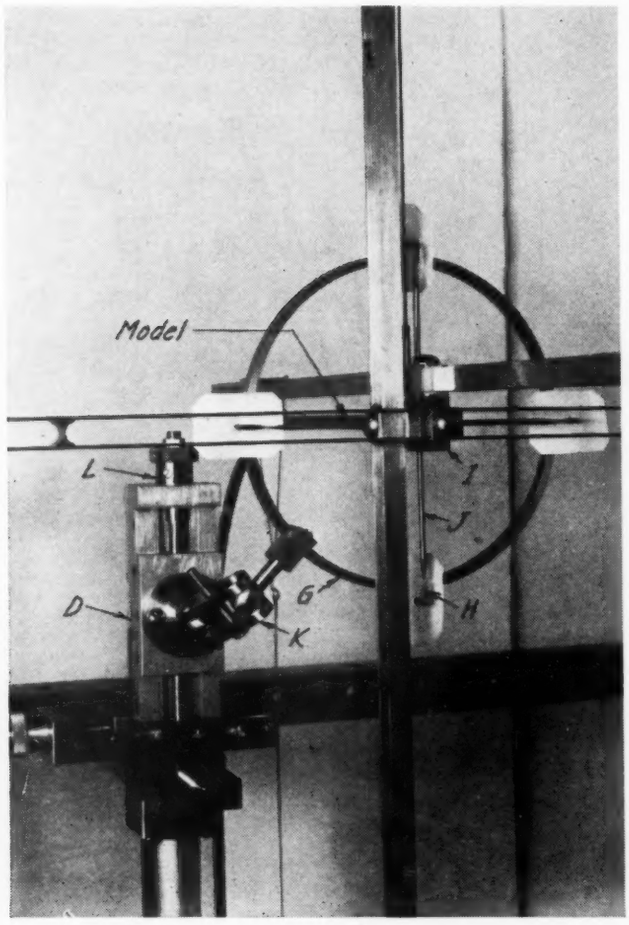

FIG. 3 CLOSE-UP VIEW OF MICROMETER HEAD, MOMENT ARMS, AND NEEDLE INDICATORS

illustrated in "Piping Hand Book" (4). The percentages of deviation range from a minimum of 3.31 to a maximum of 22.36 with an average of 8.62.

Table 2 shows a comparison between model answers and the same problem solved mathematically with the flattening factor disregarded. In this case the percentage deviations range from 9.20 to 37.12 with an average of 27.71, or approximately three times as great. It would seem logical to expect closer agreement in this case because of the closer simulation between model and prototype. The author is not prepared to explain this discrepancy. It is thought, however, that it is due to inaccuracies in the theoretical formulas as pointed out previously.

Table 3 gives a comparison between Professor Hovgaard's problem (5) and the model solution. Deviations ranging from a minimum of 10.57 to a maximum of 38.53 with an average of 20.68 per cent are indicated.

TABLE 3 PROF. HOVGAARD'S THREE-DIMENSIONAL PIPE PROBLEM ILLUSTRATED IN A.S.M.E. TRANS. (5)

(Forces are given in pounds and moments in inch-pounds)

End reactions	Mathematical	Model	Difference	Difference, per cent
Force P	1,726	2,010	284	+16.45
Force Q	1,815	2,175	360	+19.83
Force N	631.7	772	140	+22.15
Moment M_{OX}	54,715	63,800	9,085	+16.60
Moment M_{OY}	—12,608	—7,750	4,858	—38.53
Moment M_{OZ}	—127,162	—140,500	13,338	+10.57
			Average deviation	20.68

Table 4 compares the model results with those of the Karelitz-Marchant problem (6) and shows deviations ranging from 5.77 to 47.01 with an average of 20.98 per cent.

Table 5 gives a comparison of model results with mathematical answers for the two-dimensional pipe run illustrated in Fig. 4. The agreement in this case is much more favorable than in the preceding three-dimensional problems and in the branch problem to follow. The better agreement may be attributed to the absence of forces at right angles to the plane of the

TABLE 4 KARELITZ-MARCHANT THREE-DIMENSIONAL PIPE PROBLEM ILLUSTRATED IN A.S.M.E. TRANS. (6)

(Forces are given in pounds and moments in inch-pounds)

End reactions	Mathematical	Model	Difference	Difference, per cent
Force P	118	147	29	+24.57
Force N	375	350	25	—6.67
Force Q	—1,178	—1,110	68	—5.77
Moment U	—12,584	—18,500	5,916	+47.01
Moment V	102,778	87,000	15,778	—15.35
Moment W	—42,738	—31,400	11,338	—26.52
			Average deviation	20.98

TABLE 5 TWO-DIMENSIONAL PIPE RUN AS ILLUSTRATED IN FIG. 4

End reactions	Mathematical	Model	Difference	Difference, per cent
Force P	688	673	15	—2.18
Force N	1,71	1,640	70	—4.09
Moment W	156,500	138,500	18,000	—11.50
			Average deviation	5.92

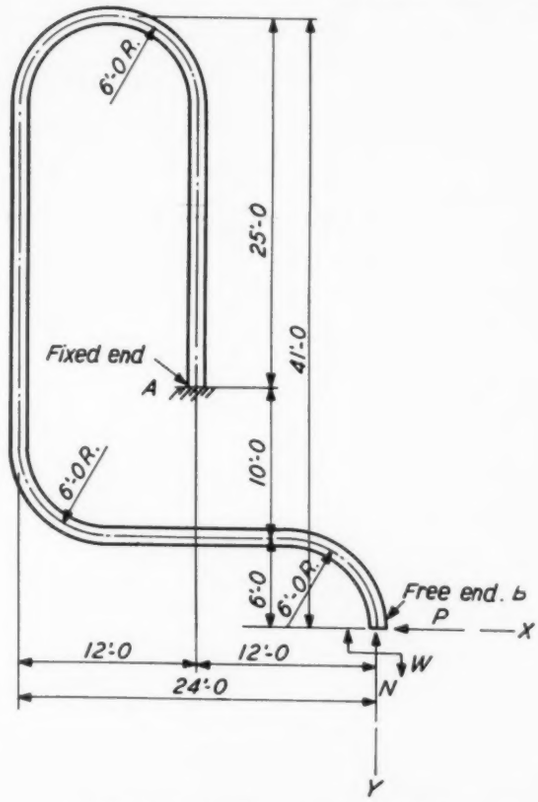

FIG. 4 TWO-DIMENSIONAL PIPE RUN

(Data: Outside diam of pipe, 10.75 in.; wall thickness, 0.718 in.; moment of inertia, 286.4; rigidity factor K, 0.854; modulus of elasticity, 23×10^6; thermal expansion, 7.2 in. per 100 ft; dx of pipe and turbine, 1.489 in.; dy of pipe and turbine, 1.657 in. Results: End reactions of mathematical and of model solutions are shown in Table 5.)

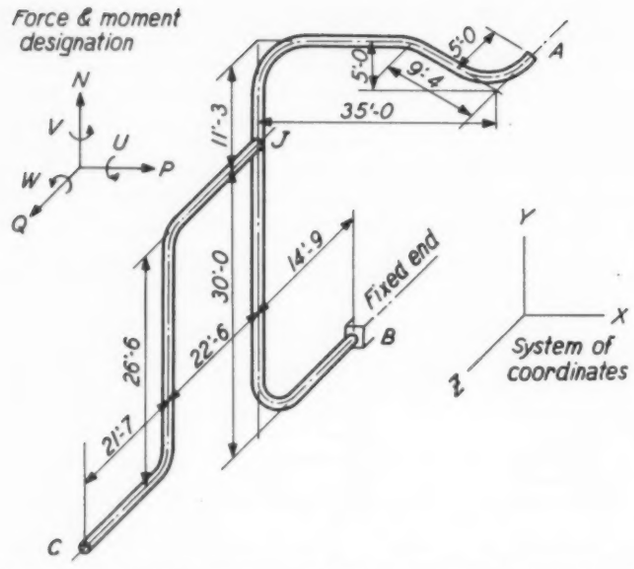

FIG. 5 DIMENSIONS, DATA, AND RESULTS OF THREE-DIMENSIONAL BRANCH PIPE RUN

DATA

Pipe run	O.D. of pipe, in.	Wall thickness, in.	Moment of inertia, I	Modulus of elasticity, E	Thermal expansion	Rigidity factor, K
AJ & BJ	12	0.843	561.75	23×10^6	7.2/100′	0.739
CJ	12	0.500	361.48	23×10^6	7.2/100′	0.50

RESULTS

(End reactions from model tests)

Reaction		Point A	Point B	Point C
Force, lb	P	−2,326	+1,885	+441
	N	−3,118	+1,380	+1,737
	Q	+1,009	+1,660	−2,669
Moment, in-lb	U	+300,009	+195,017	+41,238
	V	+122,823	+372,674	−112,382
	W	+688,439	−255,129	−120,102

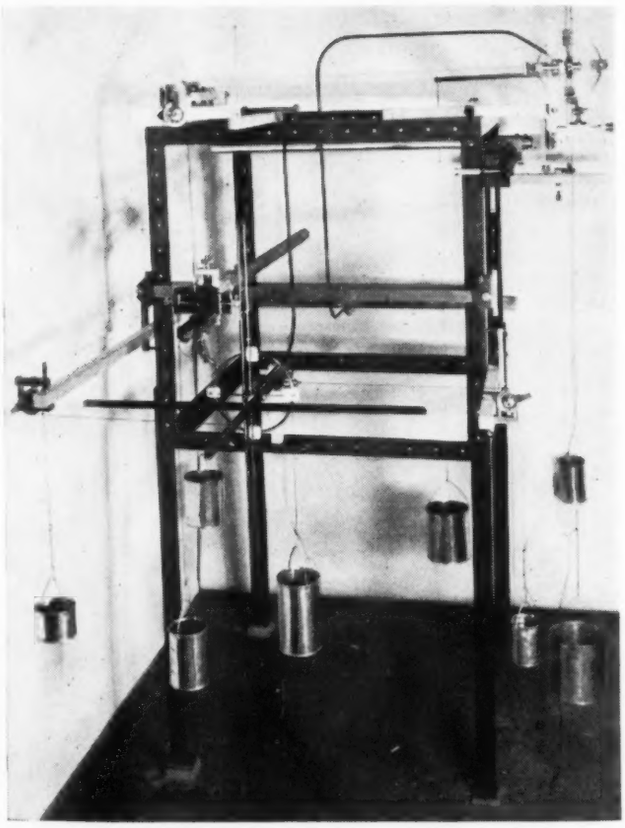

FIG. 6 MODEL SETUP OF THREE-DIMENSIONAL BRANCH PIPE RUN ILLUSTRATED IN FIG. 5

TABLE 6 PROBLEM ILLUSTRATED IN FIG. 5

(Temperature expansions at junction point J are compared with deflections obtained by substituting model-determined end reactions in mathematical formulas. Deflections are in inches and percentages are based on temperature expansions)

Pipe section	Temp., dx	Load, dx	Temp., dy	Load, dy	Temp., dz	Load, dz
AJ	−2.52	+0.585	−0.450	+2.275	+0.360	−0.769
$-CJ$	−0−	−2.370	+1.915	+0.711	−3.168	+3.108
	−2.52	+2.955	−2.365	+1.564	+3.528	−3.877
Difference	0.435		0.801		0.349	
Difference, per cent	17.26		33.86		9.89	
AJ	−2.52	+0.5847	−0.450	+2.275	+0.360	−0.769
$-BJ$	−0−	−1.8418	+2.160	+0.451	+1.062	−2.748
	−2.52	+2.4265	−2.610	+1.824	−0.702	+1.979
Difference	0.094		0.786		1.277	
Difference, per cent	3.73		30.11		54.97	
CJ	−0−	−2.37	+1.915	+0.711	−3.168	+3.108
$-BJ$	−0−	−1.84	+2.160	+0.451	+1.062	−2.748
	−0−	−0.53	−0.245	+0.260	−4.230	+5.856
Difference	0.53		0.015		1.626	
Difference, per cent	Indeterminate*		6.122		38.43	

Average per cent deviation neglecting the indeterminate value* = 24.29

bends. The average deviation in this case, 5.55 per cent, is well within the range of experimental errors usually encountered in testing the strength of materials.

Fig. 5 illustrates a three-dimensional branched pipe run with tabulated data and model results. Fig. 6 shows the model set up for testing. To the best of the author's knowledge no practicable mathematical solution for this type of problem has been produced. In order to make comparisons as in foregoing problems the model-determined end reactions after conversion to the prototype were substituted in mathematical formulas and each branch was solved as though free at the junction point J. The results are given in Table 6 with the corresponding temperature expansions. Because point J is common to the three runs, it is obvious that in any one direction the difference in expansions between two runs should equal the difference in deflections. The average deviation of 24.29 per cent compares favorably with those reported in the foregoing three-dimensional problems.

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PROGRESS *of* HIGHER PRESSURES *in the* INDUSTRIAL PLANT

Discussion of Paper by William F. Ryan

IN THE June, 1940, issue of MECHANICAL ENGINEERING, William F. Ryan, mechanical engineer of Stone & Webster Engineering Corporation, Boston, Mass., contributed a paper under this title which was presented at the A.S.M.E. Spring Meeting, Worcester, Mass., May 1–3, 1940. In this paper, the author points out the comparatively limited application in the United States of higher pressures, beginning with the first installation in 1927. While industries have utilized such pressures for power generation, their advantages in processing have not been recognized. So, too, the development of high-pressure reciprocating engines has been negligible, while turbines even in relatively small sizes have reached a high peak of efficiency and adaptability to process requirements. The conclusion is reached that the ability to generate power with a heat consumption of less than 5000 Btu per kwhr, with a plant cost—over the cost of a low-pressure steam plant—of little more than $100 per net kw, is proof of the economy of such plants when load factor, synchronism of power and steam demands, and other factors are favorable.

C. C. ANDERSON DISCUSSES COST ALLOCATION BETWEEN PROCESS STEAM AND POWER

C. C. Anderson[1] stated: In industrial-plant practice, the allocation of costs between process steam and power are often arbitrarily made on unsound bases. The most prevalent fallacy in these allocations is the assumption that the electric energy produced is a by-product of process-steam production or, in some cases where electric generation is the principal consideration, the process steam, obtained by extraction from turbines, may be considered as the by-product. The commodity which is considered to be the by-product is usually favored in the cost allocation. Fuel-cost allocations based on reduction in enthalpy of steam or based on available energy show widely varying results.

In the writer's opinion, the only fair basis for allocation of fuel costs between power and process steam is one in which each commodity shares equally in the over-all saving inherent in the combined production of electric energy and process steam, as compared to the costs of producing each commodity separately. For the plant in which process steam is obtained by extraction from condensing turbines, however, the problem is not too difficult for practical application.

Assuming such a plant, the cost of electric generation on the basis of no process-steam extraction can be readily obtained by calculation or from actual test results. The cost of producing the process steam independent of electric generation also can be estimated quite accurately. The sum of these two individual costs, compared to the actual cost of combined operation, determines the saving which should be shared equally by the electrical and process-steam departments. One half the saving subtracted from each of the individual costs representing independent operation will give the allocated costs for power and process steam. This is illustrated by the following example:

ACTUAL PLANT OPERATION

(From plant records)

Total power generated, 24-hr period, kwhr	96000
Total process steam supplied, 24-hr period, lb	480000
Total coal burned, 24-hr period, tons	96
Total cost of fuel at $3.50 per ton	$336

HYPOTHETICAL OPERATION

(As determined by calculation and representing each commodity produced separately)

	Tons
Coal required to generate 96,000 kwhr	82.3
Coal required to supply 480,000 lb process steam	30.1
Total for this basis	112.4

FUEL AND FUEL-COST APPORTIONMENT

	Tons
Hypothetical total fuel requirements	112.4
Actual fuel requirements	96.0
Saving due to combined operation	16.4
Equal saving to be credited to each department	8.2
Fuel apportioned to electric generation, 82.3 — 8.2 =	74.1
Fuel apportioned to process-steam production, 30.1 — 8.2 =	21.9
Total (to check with actual tons)	96.0
Cost of fuel apportioned to electric generation at $3.50 per ton	$259.35
Cost of fuel apportioned to process steam at $3.50 per ton	76.65
Total (to check with actual cost)	$336.00
Per cent fuel chargeable to electric generation	77.19
Per cent fuel chargeable to process requirement	22.81
Total	100.00

The reason for dividing the saving equally is that power production alone could not realize this saving, or any part of it, without the process-steam-load requirements, or vice versa, so that each department is indispensable to the other in this respect.

The allocation of labor charges, fixed charges, and the various costs, other than fuel, also will be more equitably determined if the same principle is applied, i.e., each department should proportionately share in the over-all saving resulting from the economies inherent in the combined operation of both departments.

KERR ATKINSON ADVOCATES MAXIMUM PRACTICABLE THROTTLE TEMPERATURES

Kerr Atkinson[2] commented upon the author's example of using a maximum practicable throttle temperature with a thoroughfare superheater to condition suitably the exhaust steam for process use, as follows: For economy of power production in such plants there is no question but that the use of maximum practicable throttle temperature is axiomatic. However, in many cases it develops that limitations other than materials govern the specification of throttle temperature. No doubt the throttle temperature is often thoughtlessly selected at too low a value, on the offhand assumption that the existing process-steam temperature governs the selection.

[1] Engineer, The United Light and Power Service Company, Chicago, Ill. Mem. A.S.M.E.

[2] Engineer, Jackson & Moreland, Engineers, Boston, Mass. Mem. A.S.M.E.

However, it is frequently possible to make a judicious compromise of throttle and back-pressure temperatures with some over-all gain and preservation of a fundamentally simple setup.

In the designs with which the writer is familiar, the throttle temperature has invariably been set at the highest conservative value consistent with available materials, except where the additional first cost or operating complications of the equipment necessarily associated with high temperature set a lower economic limit.

The writer has checked back over 18 to 20 by-product power projects which have been studied in his organization totaling some 200,000 kw, about one half of this capacity being actually constructed and operating. Four cases were found in which the temperature was set at 675 F. Two of these were established in 1929 where the ratio of steam-to-power requirement was so great that even in the succeeding 10-year period, the by-product power limit has not been exceeded. The value at that time of additional by-product power ability would have been negligible. The other two were fixed by maximum steam temperature which could be obtained by remodeling existing boilers. There is one project fixed at 700 F with equipment bought for future operation at 750 F. There are two recently investigated projects, one specified for 800 F and one for 925 F in conjunction with 1250 psi. The latter was for operation by a utility. Temperatures of 725 to 750 F were specified for all of the remaining projects, this being considered the conservative upper limit for industrial-power-plant conditions during the period in which these projects were analyzed.

Beginning in 1929 or earlier we considered thoroughfare exhaust desuperheaters on a number of occasions but, in the circumstances peculiar to most of these projects, neither the cost nor the complication seemed to be warranted. In one instance in 1933, we proposed a thoroughfare desuperheater where the steam to be conditioned came in varying proportions from three separate sources with widely different initial superheats (50 to 300 deg). An example recently analyzed indicated that the cost of building high temperature into the boiler plant plus the desuperheater cost exceeded the cost of building for a pressure enough higher to give equal by-product power ability. However, the findings for these projects in no way prove that there are not many applications for such a type of installation.

The writer wishes to emphasize that this discussion is not intended as a refutation of the claim that thoroughfare desuperheaters have economic applications. It is intended rather to confirm the author's point that every case requires careful consideration of its own special problems and that, where the special considerations differ, the answers may differ. The economic and practical industrial power plant cannot be selected from a catalog.

L. W. BATES DESCRIBES NAVY YARD POWER PLANTS

L. W. Bates[3] wrote: The Bureau of Yards and Docks has cognizance over the power plants of the shore establishment of the Navy Department and has been giving this subject close attention for some time. During that period when the author might have included 450 psi in the high-pressure classification, five boilers for that pressure were installed in two yards and one for 650-psi drum pressure in another, and within the last year boilers for this pressure have been ordered for another yard. In addition, boilers for high-pressure operation in the future have been installed, but are being operated at lower pressures until new prime movers are installed.

Although the Navy Yard power plant may be classed as an industrial plant, its function is even broader since it is the source of supply for not only electric light and power but also for industrial steam, building heating, compressed air at about 100 psi and up to 3000 psi for torpedo charging, fresh water for domestic use and salt water for flushing and fire protection, water at high pressure for hydraulic-press operation and, in fact, all utilities for a self-contained industrial community. It must be completely self-contained and self-sufficient. Although economy is important, continuity of service is the prime requisite; failure of any service might invite national disaster.

It is impossible to forecast future loads with the same degree of accuracy as for the usual industrial plant. Unexpected increases may come almost overnight. Public-utility service can be obtained more quickly than new generating equipment, but the former has lacked capacity during national emergencies and is subject to interruptions due to lightning; also the difficulty of guarding transmission lines to protect against possible sabotage is a matter for serious consideration. Consequently, old generating equipment cannot be scrapped merely because it is no longer economical. It can be removed only to make room for larger capacity and must be held for emergencies so long as it is in operating condition. If high pressure is adopted for new equipment, the plant must become a two-pressure plant with bleeder turbines, reducing valves, desuperheaters, and other complications.

Another factor determining design is that of steam supply for heating, industrial use, and supply of ships when berthed at the yards when their own plants are being overhauled. This item varies with load, climate, seasonal temperature, yard activity, and type of work assigned to the yard.

Studies have been made for conditions as high as 825 psi, 900 F total temperature, but, because of the high steam load, very little economy was shown over 600-psi operation. To select any higher pressure throws the piping immediately into the 900-lb classification with a large increase in piping costs which does not seem to be justified for our conditions.

There can be no standard classification as to our bleeding pressures. Differences in existing steam-distribution systems require varying pressures. In some cases all steam other than that required for air compressors can be bled with resultant high economy. In other cases only heating and local uses can be obtained from bled steam. Where operating conditions permit, steam used for operating reciprocating air compressors and auxiliary piston-driven equipment will be bled from high-pressure turbines.

It is too early to discuss operating experiences but we have full confidence that the use of higher pressures is not only justified economically but offers no more operating difficulties than does the low-pressure apparatus.

M. K. BRYAN INDICATES WIDE ACCEPTANCE OF HIGH PRESSURES

M. K. Bryan[4] stated: Management's skepticism concerning the practicability of higher pressures for the industrial plant has gradually decreased as experience with increasing pressures brought about the development of equipment, demonstrated the competence of operators, and indicated practical solutions of the many problems which were created. Experience has removed hazards, both actual and imaginary and, today, it appears reasonable to say that management's fear of high pressures is practically nonexistent. Operators who have taken over high-pressure plants, and with previous experience confined to pressures 200 psi and below, will, after the period of their stage fright is over, generally prefer to operate the high-pressure plant.

Refinements in process machinery and operations can advisedly be considered to determine or forecast their effect upon

[3] Project Manager, Bureau of Yards and Docks, Navy Department, Washington, D. C.

[4] Consulting Steam Engineer, Chas. T. Main, Inc., Boston, Mass. Mem. A.S.M.E.

process-steam pressure and demands, and upon power consumption. In some industries, there is a noticeable trend toward increased pressure requirements for process use, a decreasing use of process steam per unit of production, and an increase of power consumption per unit of production. It therefore would appear to be prudent, when selecting pressure and temperature, to consider making allowance for a future ratio of steam and power requirements which may be less favorable to the electric-power yield than the present ratio.

The writer's knowledge of results with plants of about 600 psi pressure, 750 F temperature, with pulverized-coal-fired boiler units in capacities of 100,000 to 120,000 lb per hr, topping old 175- to 200-psi plants, through noncondensing turbogenerator units, shows availability of prime movers in the order of 95 to 98 per cent and of boilers in the order of 85 to 90 per cent.

Formulation of construction costs, as the paper points out, is not practical, and each installation must be estimated. A comparison of the weighted-average installation costs, developed by the paper, with the cost of a recently completed 600-psi topping installation, shows the latter to have cost $7\frac{1}{2}$ per cent more per lb of steam capacity and 25 per cent less per kw of electric-generating capacity than the weighted averages. The costs in this case were distributed, 57 per cent for steam-generating-plant equipment, 31 per cent for electric-generating-plant equipment, and 12 per cent for building alterations, foundations, and such physical structures.

The excess cost of the complete high-pressure plants over the cost of plants designed to deliver the same quantities of low-pressure steam, namely $105 per net kw, may be thought of as the equivalent of a demand charge of $1.20 per kw per month for electricity purchased when operating the low-pressure plant and not having electric power generated as a by-product to the process-steam uses. Thought of in this way, the energy charge for the purchased electricity is to be compared with the production expense for the by-product power made by the high-pressure plant. Assuming 5000 hr annual use of generating capacity, about 57 per cent load factor, and 4 mills saving on energy charge, then the complete plant would earn $20 per annum per kw of capacity after fixed charges; in other words, a net of about 20 per cent per annum on the excess cost.

PAUL H. BUXTON CITES OPERATING EXPERIENCES

Paul H. Buxton[5] pointed out: Studies for the plant with which the writer is connected indicate that the most economical condition would be high-pressure-steam generation at 650 psi, 750 F total temperature. The high-pressure turbines have two extraction points, one, 150 lb gage, the other, 50 lb gage, and exhaust against a back pressure of 20 lb. The low-pressure machines which were moved from one of our other plants consist of one mixed-flow machine taking steam at both 150 lb and 20 lb and a straight bleeder-type machine taking steam at 150 lb and extracting at 20 lb. Had the equipment been purchased new, we probably would not have made exactly the same selection.

Our results have been most gratifying and in general fall within the figures indicated in the paper. It is noteworthy that all of us were apprehensive of the difficulties in treating 18- to 24-grain hardness ground water having a high iron content. A thorough study was made to determine the proper treatment. The operating results indicate that we have been successful, since our availability for the steam generators has averaged 92 per cent for a 12-month period with no burned-out tubes or other difficulties on the water side.

On the fire side of the boilers, we have had considerable difficulty from slagging, especially when running at high rating. This is probably due to the fact that we are burning Illinois coals which are high in volatiles and ash, with a low fusing point for the ash.

The station has an installed capacity of 10,000 kw and peak capacity of 150,000 lb of steam per hr.

DATA FROM POWER-PLANT STUDY

Gross kw per M lb steam	49.5
Net kw per M lb process steam	12.0
Gross kwhr generated	35,000,000
Net kwhr to manufacturing	29,000,000
Steam/rated capacity, per cent	66
Since we have low power factor due to process, the kwhr per kw installed-capacity comparison is of no value here.	
Cost per M lb steam (all charges included)	$0.34
Delivered coal cost per million Btu	0.10
Cost per installed kw	94.60

In concluding, a word of caution may be in order. Any design must be flexible enough to permit future modification in order to meet changing conditions in process.

O. F. CAMPBELL BELIEVES ADEQUATE FEEDWATER TREATMENT TO BE FACTOR IN ADOPTION OF HIGHER PRESSURES

O. F. Campbell[6] said: It appears to the writer that the major drawback toward higher steam pressures in industrial power plants has been the fear of boiler failures due to improper boiler-feedwater treatment. As soon as the boiler manufacturers and the water chemists assure industrial executives of safe high-availability boilers, then and only then will more high-pressure boilers be built for industrial purposes.

High-pressure industrial boilers will in many cases effect greater economies by the use of steam in process rather than for electrical-energy generation. Where electrical-energy failures in process work substantially mean disaster or loss of production, there is a general tendency toward operating turbine-driven equipment with high-back-pressure turbines for safety and economy.

In the building of new industrial plants, the utilities cost of the new plant is paramount and before such a plant is built a careful study of utility requirements should decide the economic steam pressure to use.

There appears to be no concern regarding the ability of industrial operating personnel to handle the high-pressure equipment, inasmuch as many oil refineries operate at pressures between 1500 and 5000 psi with safety, handling a more dangerous fluid than water. With properly designed equipment, there appear to be no fears on the part of the operators whether the pressure is 50, 500, or 5000 psi. The future may find yet higher pressures and much higher temperatures in use than could possibly prevail in a boiler plant. Oil-refinery engineers are not particularly concerned over oil-vapor temperatures, in the neighborhood of 1300 F and 4500 lb pressure. The future is great for the high-pressure industrial boiler plant.

OLLISON CRAIG GIVES DATA FOR PAPER-MILL POWER PLANTS

Ollison Craig[7] stated: The writer has tabulated data covering the steam-generator installations for use in paper mills which have been sold by his company since 1934. The results of the tabulation are shown graphically in Fig. 1 of this discussion. Steam pressures and temperatures were plotted to determine whether any trend was discernible. For each calendar year, the maximum steam pressure of any installation and the minimum steam pressure of any installation were plotted

[5] Chief Engineer, Western Cartridge Company, East Alton, Ill. Mem. A.S.M.E.

[6] Combustion Engineer, Sinclair Refining Company, East Chicago, Ind. Mem. A.S.M.E.

[7] Engineering Manager, Riley Stoker Company, Worcester, Mass. Mem. A.S.M.E.

as points and the maximum points were connected together in a curve while the minimum points were connected together in a second curve. In a similar manner, maximum steam temperatures were plotted to form a curve and minimum steam temperatures were plotted to form a second curve.

The data on which these curves are based cover a total steam-generating capacity of 3,100,000 lb of steam per hr divided among 23 boilers in 16 plants. The minimum capacity of a single boiler unit is 50,000 lb of steam, and the maximum is 375,000 lb of steam, while the average is 135,000 lb of steam. These data of course are not conclusive but do seem to indicate something in the nature of a trend, and may be the result of the type of study that should be given to a particular case in determining the best pressure and temperature, as pointed out in the paper.

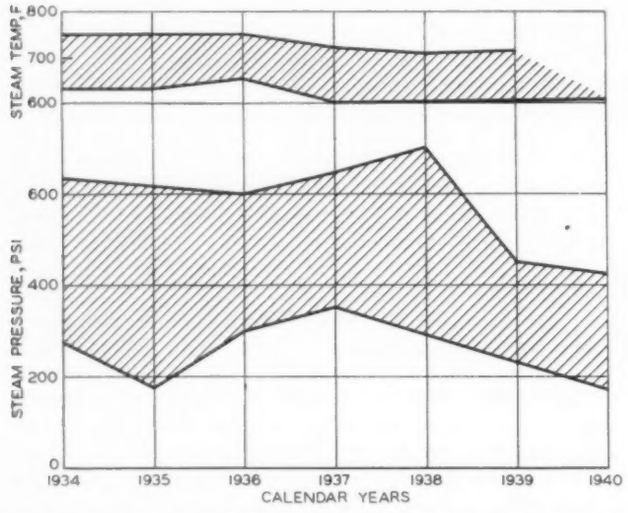

FIG. 1 UPPER AND LOWER STEAM PRESSURES AND TEMPERATURES OF BOILERS INSTALLED IN PAPER MILLS BY WRITER'S COMPANY SINCE 1934

F. H. CRONIN ADVOCATES HIGH PRESSURES FOR SMALL PLANTS

F. H. Cronin,[8] speaking of the paper and vulcanized-fiber industry, said: The writer's experience would indicate that there are great opportunities for effecting savings by the installation of back-pressure units, even in comparatively small plants.

In the so-called low-pressure field for processing work many combinations in the use of steam may be worked out. In one case of 600 psi throttle pressure, steam is extracted at 125 psi, used in a variable-speed engine for paper-machine drive, and, thence, is exhausted to paper-machine driers at from 2 to 15 psi. All of the processing equipment, although built many years ago, still functions properly, yet it is not designed for any appreciable increase in applied pressure.

The author cites a case in which changing the process pressure from 10 psi to 150 psi reduced the steam consumption approximately 50 per cent. While details are lacking, the inference is that the process was one in which an increase in temperature of the heating medium of at least 120 F made no difference in the quality of material processed.

The writer will cite the case of a small plant in operation for $4^1/_2$ years which has produced a handsome return on the investment. The processes consist essentially of rag cooking and pulp preparation, paper drying, fiber making, drying, pressing, and conditioning, as well as reclamation of zinc chloride by vacuum evaporation.

[8] Chief Engineer, National Vulcanized Fibre Company, Yorklyn, Del. Mem. A.S.M.E.

All of the processing equipment involved had been installed a number of years before, and yet was in good operating condition.

Previously these processes had been supplied by steam generated at 125 psi under oil-fired water-tube boilers and throttled to meet the individual requirements. In anticipation of installing a generating plant as well as supplying steam for processing, a survey was made of both steam and power requirements.

It was decided that the temperature corresponding to 40 psi saturated steam was about as high a temperature as the process would stand. Furthermore, 40 psi was the highest pressure for which most of the process equipment was designed, requiring in a few cases reduction through throttling to meet the needs.

The power required could be generated most economically by adopting 600 psi. Steam was extracted at about 125 psi at the end of the impulse stage on the back-pressure turbine. The inlet temperature of the steam at the throttle was selected at 700 F; this gave a small degree of superheat at the exhaust which was taken care of by a desuperheater located in the line for the immediately contiguous processes, whereas, the processes remotely located were not affected by the low degree of superheat remaining.

To meet the power requirements, one 1000-kva, 80 per cent power factor, back-pressure turbine, extracting at the end of the impulse stages, and one 500-kva, 80 per cent power factor, combined bleeding-and-condensing-type turbine were installed. The latter turbine bleeds at 40 psi up to its capacity, condenses and bleeds up to its capacity, but condenses only up to about two-thirds capacity.

OPERATION OF PLANT

Generally the load requirements are such that it is necessary to run both turbines together. In this case, the back-pressure turbine is under back-pressure control, while the small turbine maintains the frequency. They function with perfect satisfaction under this method of operation. As the process pressure varies above or below 40 psi, the large machine drops or picks up load accordingly, the smaller machine operating in reverse order. When the load is light enough to warrant, the back-pressure turbine is operated by itself under back-pressure control. Even under this method of operation, the frequency does not vary enough to make any difference, since the system varies as a whole.

What few interruptions this plant has sustained in $4^1/_2$ years of operation have not been due to the prime movers as such, nor to the boilers, nor to the operating personnel, but more particularly to the smaller pieces of apparatus such as motor-generator sets, boiler feed pumps, or boiler-feedwater supply.

The make-up water for this plant never runs less than 50 per cent and may be as high as 75 per cent at times, yet results show that the feedwater treatment adopted is adequate to the situation. After about 3 years of operation, it became necessary to open up the back-pressure turbine for scraping. The feedwater treatment was changed slightly to meet this condition and it is believed that the trouble has been remedied. The small turbine has never been opened up except for observation.

PLANT INVESTMENT

The cost of this plant was $230,000. The rated output of the turbogenerators is 1500 kva at 80 per cent power factor with a steam-generating capacity of 100,000 lb per hr in two boilers, only one of which is used at a time. No new buildings were required, modification of existing housing facilities was sufficient to accommodate new equipment.

The boilers may be either oil-fired or fired by individual

pulverized-coal equipment. To date, oil-firing has been used, equipment for which was already installed. Pulverized-coal equipment was purchased new. However, existing coal-handling and storage equipment sufficed for the situation.

The investment cost includes a 150-hp gasoline-engine-driven generator set which can be used in an emergency, in case of flood waters, to get boilers under steam.

OPERATING COST

The fuel cost for 1939 was $61,145; operating and maintenance expense, $21,800; maintenance materials, $4500 (consisting mainly of chemicals for boiler-feedwater treatment).

The plant has not failed to return a saving of $39,000, less depreciation, per year since it was placed in operation, even in consideration of the poor business years since 1935. The best year showed a saving of approximately $55,000.

The output for 1939 was 6,360,000 kwhr measured on the high-tension side of company-owned transformers. The minimum year showed 4,215,000 kwhr; and the maximum, 7,690,000 kwhr. The boiler output was 276,000,000 lb of steam for last year, with an average efficiency of boiler and furnace of 81.5 per cent. The boiler output has varied from year to year from a minimum of 216,000,000 lb to a maximum of 314,000,000 lb.

In this particular small plant, it has been found that the quantity of fuel used in the high-pressure plant has varied from 2 to 11 per cent more than was formerly required by the old plant when generating steam for process work only. For the last calendar year, 11 per cent of the fuel cost was chargeable to power, or 1.06 mills per kwhr. For 1939 the fuel cost was 17.7 cents per million Btu, but it has been as low as 17 cents. The operating cost per 1000 lb of steam and 23.04 kwhr, from fuel costing 17.7 cents per million Btu, was 31.7 cents. Over the entire $4^1/_2$-year period it can be demonstrated that the Btu per kwhr is well under 5000.

The ability to generate a kilowatthour with a fuel consumption of less than 5000 Btu in a plant as small as the one described would certainly lead the writer to recommend a thorough digest of this paper and a more thorough consideration of the possibilities of high-pressure industrial plants.

Z. G. DEUTSCH VIEWS STEAM AND POWER GENERATION AS JOINT PROBLEM

Z. G. Deutsch[9] commented on the paper as follows: The data given in the paper on the number of plants and their sizes indicate an average plant somewhat under 10,000 kw. About 284,000 kw or 34 per cent is stated by the author to be operated by public utilities and the remaining 66 per cent by manufacturing concerns. The author's data on the number and average size of plants in each group would be appreciated.

From the data which are given in Tables 1, 2, and 3 of the paper, it might be deduced that the median high-pressure industrial power plant has a 5000-kw prime mover, operating at nearly 650 psi and 750 F total temperature at the throttle and over 100 psi back pressure. There need be no question regarding the practicability or efficiency of these small-size units.

The author states that, if the electric-power demand is high in proportion to the steam required for process, it may be economical for the industrial plant to use the highest pressures commercially available. It is added that, in a number of industries which might be put into such a category, the electric-power demand had a decided tendency to increase in proportion to the steam demand. Most American manufacturing industries follow this rule. This circumstance flows from a number of causes. Probably foremost among these is that in America the elimination of burdensome and monotonous manual labor is generally concomitant with the consumption of more electric power. Secondly the consumptions of process steam are on the whole such that Rankine-cycle efficiencies of a low order are the rule. Improvements by the operating personnel are in many plants continually reducing steam consumption. Furthermore an industrial plant's growth, by the commonly practiced expedient of diversification through end-product manufacture, whether brought about by research or merger, most often involves a new electric-power demand, higher in proportion to new process-steam demand than was the original.

It behooves those considering such power plants to look well ahead, taking into consideration not only the fact that electric-power demand may increase with a steam-demand decrease but also that the availability or potential output of by-product power may attract by-product manufacturing, leading to an over-all increase in the prosperity of a venture.

One cannot agree too strongly with the author's statement that steam-and-power generation must be considered as a joint problem in order to secure the lowest over-all manufacturing costs. As an example of the possibilities, attention is drawn to a case where an engineering concern specializing in the power-plant field designed a new power station for an industrial plant, basing all calculations on process-steam conditions and consumptions per unit of product as stated by the client. Fig. 2 of this discussion shows actual month-by-month variations of an important unit steam consumption in this case. The time abscissa starts only a year or two after the new power plant, as designed by the engineers, was placed in operation. The dotted curve is a 12-month moving average. The result of this unfortunate set of circumstances was that this industry became burdened with an obsolete, but much unamortized, power plant.

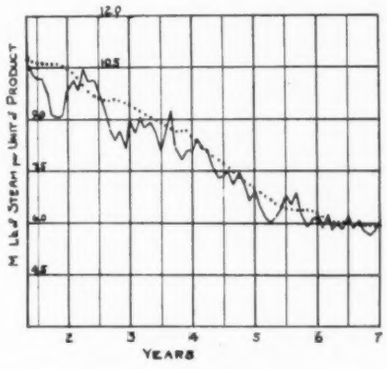

FIG. 2 MONTHLY VARIATIONS IN UNIT STEAM CONSUMPTION OF TYPICAL HIGH-PRESSURE INDUSTRIAL POWER PLANT

The author's belief that higher steam temperatures should be sought in industrial-steam-plant development is certainly justified. His statement that ". . . in many processes superheat is of no value. . .," can be considered true only with the proper interpretation of the word "many." Numerous writers have stated without qualification that superheated steam is disadvantageous for evaporation processes. This belief is fallacious in more than 90 per cent of the cases met with in today's industrial practice. A desuperheater degrades energy (increases entropy) and, hence, engineers should try to determine means of avoiding its use or necessity.

The author refers to the number of extraction nozzles and the number of levels for industrial steam. Many different pressures exist in some plants because of their erratic growth. A controllable extraction pressure frequently represents a considerable economy, over a period of years. The reason for this is

[9] Consulting Chemical and Mechanical Engineer, New York, N. Y. Mem. A.S.M.E.

illustrated in Fig. 3 of this discussion. Fewer industrial plants can be operated as base-load stations than can public utilities. Consequently, they are frequently faced with long periods of low-output operation. It is inherent with substantially all industrial processes, that steam consumption bears a more nearly linear relationship to product output than does electric-power

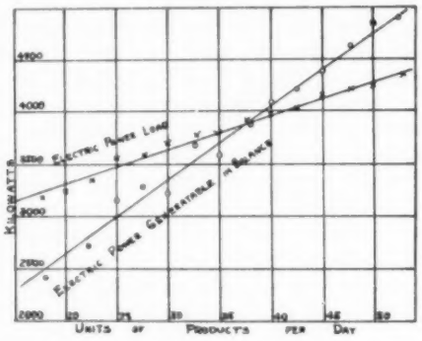

FIG. 3 PRODUCT OUTPUT FOR TYPICAL PLANT

consumption. Such electric loads as agitators, screw conveyers, and feeding devices, all remain at a substantially constant level, as long as they are running at all. This fact is illustrated for a more or less typical industrial plant by the two lines in Fig. 3. One such pair of curves can be drawn for each of several steam-pressure-temperature combinations considered for a power plant. For higher enthalpy and lower entropy conditions, the point at which the two curves intersect proceeds further and further to the left. Except at prohibitively high capital investment in power plant, an industry is bound to be faced with periodic operations at outputs to the left of the point of intersection. Then it is necessary to purchase electric power, or blow exhaust to the atmosphere. Under those conditions a marked saving can be effected by switching to a lower extraction pressure on such process-steam demands, which can produce the smaller output at a reduced pressure. Such loads are much more prevalent than one would at first consider possible. Turbines with a number of nozzles, to furnish alternate lower extraction pressures at lower loads, should receive careful consideration.

The dimension "per hour" should be added to the figure of 22.5 lb of steam per sq ft of boiler heating surface, near the beginning of the discussion of steam-generating equipment.

RESERVE CAPACITY OF POWER PLANTS

Reserve capacity of power plants is intimately connected with the consideration of reserve capacity in manufacturing equipment or accumulator, silo, and warehousing facilities for manufactured products. One of the principal reasons for the willingness of owners to depend for factory production, wholly or partially on a single high-pressure boiler or turbine unit, has been that they have found product silos or their equivalent not only considerably cheaper than reserve boilers or generators, but also that flexibility is provided in their operations. The silo protects against interruptions in many important lines of production, from the source of raw materials through to the end of the process. Continuity of service from the utilities is not strictly comparable with that provided by the majority of the plants studied by the author. Most of these plants are able to schedule shutdowns of power-producing equipment to fit in with normal capacity fluctuations in production. Silo or warehouse stocks are normally built up in anticipation of a routine boiler or generator outage for "preventive" maintenance work. Consequently the availability factors of 89 to 87 per cent given in Table 4 of the paper are not strictly comparable with the same type of availability factor in the central station serving a diversified load with its typical 365-per-year periodic variations.

The extraordinarily high efficiency or low Btu per kwhr consumption, reported in Table 4 for 8 per cent of the 85 plants, merely indicates that, compared to central stations, relatively little of the heat and fuel goes directly to stack or sewer. Much more convincing are the before-and-after figures of tons of coal or Btu per unit of product manufactured by the industry. What would the availability and other factors have been, had the one plant with reserve capacity not been omitted?

The weighted-average installation costs given in the paper are authoritative enough to be of tremendous value to the membership for early visualization of projected high-pressure industrial plants. The weighting which the author has done has had a surprisingly small effect because his formula, applied to the total of the back-pressure installations, works out fairly well.

The final paragraph of the author's summary lacks the recommendations which the less-seasoned engineer is tempted to make as a result of such a study. Certainly tremendous savings can be made in American industry through the ability to generate power for the heat-consumptions and investments indicated. Many plants are too small to undertake the necessary, sometimes expensive, study. Might not public utilities, operating central stations in highly industrialized areas, make the studies for a large group of their industrial customers? They might thereby protect against loss of load where new high-pressure plants may be installed for inefficient processes and might also pick up considerable new load, while at the same time showing their customers how to make a considerable saving in fuel.

G. D. DODD EXPLAINS USES OF EVAPORATIVE CONDENSERS

G. D. Dodd[10] called attention to the reference in the paper of the extreme importance of proper feedwater preparation in high-pressure industrial plants: It is noted that the energy loss resulting from the use of evaporative condensers (heat-transformer evaporators) is less than commonly supposed.

For example we have considered a simple fundamental power-process steam cycle consisting of a 1200-psi-abs 900-F boiler, supplying steam to a nonbleeding turbine, exhausting at 65 psi abs, producing a constant quantity of 98,500 lb per hr of steam for process at 1197 Btu. Feedwater from the discharge of a boiler-blowdown heat exchanger is heated by the exhaust from the turbine to a boiler-feed temperature of 290 F. Several values of blowdown from the boiler were assumed and calculations made of the kw produced.

As a comparative cycle, the same conditions were assumed, supplying steam to a turbine exhausting at 87 lb abs into an evaporator producing a constant quantity of 100,000 lb per hr of process steam at 1179 Btu. The condensed steam from the evaporator coils at 318 F is pumped directly to the boiler as feedwater. The injection temperature of the treated feed to the evaporator shell is at 70 F. Since the same total heat to process with the two cycles is to be maintained, it is necessary in this case to supply 100,000 lb per hr instead of 98,500 lb per hr where no evaporator is used. The Btu values of the steam to process are slightly different with the two cases.

The cycle described last, including the evaporator and with no boiler blowdown, produces 8060 kw. Analysis of the first cycle, including a blowdown heat exchanger but no evaporator, shows that 8060 kw is produced with blowdown at 23.1 per cent of the injected feed to the system. There is, however, a loss of approximately 900,000 Btu per hr not recoverable in the heat exchanger, due to a terminal difference of 30 F.

This nonrecoverable loss in the heat exchanger is equivalent to 260 kw. Further reference to calculations made indicates

[10] Foster-Wheeler Corporation, New York, N. Y.

that if the blowdown is reduced to 17.5 per cent of the injected feed to the system a kw output of 8250 will be developed. Because of the lower blowdown the loss from nonrecoverable blowdown heat in this case is equivalent to 190 kw. Debiting this loss to the 8250 kw produced results in a net equivalent-power output of 8060 kw, which compares to the evaporator cycle.

Summarized, this is to say that equivalent power outputs are secured with the two different cycles when the blowdown from the nonevaporator cycle equals 17.5 per cent of the injected feed to the system.

This amount of blowdown is not unusual and, for example, would result in a concentration of 1000 ppm in the boiler if the treated feed to the system contained 175 ppm. Many boilers and conditions require lower concentrations than stated herein and many waters contain more than 175 ppm in the treated feed.

Decreased boiler concentration or increased solids in the feed would result in greater blowdown and hence a power output from the evaporator cycle in excess of the power output for the nonevaporator cycle. Increased back pressure, with other conditions remaining the same, has little effect on the comparative power outputs of the two cycles. Decreased steam pressure has a somewhat greater effect because of the lower heat content of the blowdown water and the decreased availability loss due to this blowdown.

E. J. GRIMMETT OUTLINES FACTORS OF POWER-PLANT DESIGN

E. J. Grimmett[11] wrote: The data presented in Table 4 of the paper represent averages and trends which should stimulate the thinking of industrial-power engineers, but which should not necessarily be used as a basis of design for any particular plant. It is difficult to visualize any two industrial plants even approximately approaching the same requirements, in so far as the correct design would be influenced by the following important factors:

1 Local physical conditions
2 Capacity
  a Steam
  b Electric
3 Relay capacity
  a Steam
  b Electric
4 Concurrence of steam and electric load
5 Initial steam pressure
6 Steam temperature
7 Back pressure
8 Extraction pressures
9 Amount and quality of make-up water

Data in the paper indicate that the majority of industrial-power engineers are primarily interested in operating results obtained from small units. Believing that specific results on availability will be of value, the writer presents the results for the year 1939 for such a plant, having a single boiler and a single turbogenerator unit as follows:

	Turbogenerator, per cent	Boiler, per cent
Service factor	93.17	95.70
Availability factor	93.31	96.13

During the year, there were no complete unscheduled outages. There were three periods, however, ranging from 17 to 35 min duration, when it was necessary either to reduce the load on the unit or take it out of service for minor difficulties.

There are two points, mentioned by the author, which will be of interest in connection with this record. The make-up boiler feedwater amounted to 24.7 per cent of the total feed. This water has a total hardness content of 16 to 18 grains per gal. Except for the supervision of the plant, none of the operating crew had any experience with power generation prior to the latter part of 1936. Their steam-generating experience had been confined to firing natural-draft equipment operating at 150 psi.

The author calls attention to the fact that 29 out of the 95 plants surveyed have a single high-pressure boiler. We would assume that most of the 29 are also dependent upon a single generating unit. It would be of interest to know how many of these 29 plants are entirely dependent upon a single boiler and generating unit, as well as what their experience record has been in so far as curtailment or loss of production is concerned.

The amount, if any, of reserve capacity to be installed is frequently the deciding factor in the prospectus made to determine the comparative cost of generated power versus purchased power, due to the fixed charges on the investment for a small high-pressure plant being unusually high. In one single-unit plant, upon which the writer has records, where the boiler operated at an annual capacity factor of 66.74 per cent and the turbogenerator at 72.14 per cent, the annual fixed charges were 18.85 per cent (not including interest) of the total cost of the process steam and power generated. Had 100 per cent reserve capacity been installed, the fixed-charge cost would have been almost doubled, and would have reduced the saving made by the new plant almost 50 per cent. No criterion can be given that can be followed in determining the solution to this important feature, as each industrial plant must be considered individually. The possible solutions are numerous.

A symposium, such as the author suggests, which would lead to a standardization not only in bookkeeping methods for proper division of steam and power cost, but to a standardization also of all bookkeeping and record-keeping methods pertaining to industrial steam and power generation, would be a long step in the direction of giving the engineer in this field the tools to permit an intelligent analysis of these costs.

H. D. HARKINS GIVES OPERATING EXPERIENCES

H. D. Harkins[12] stated: The observations in this discussion are based upon the du Pont Company's experience with three 400-lb and four 600-lb steam-electric plants. Two additional 600-lb plants are under construction. The steaming capacity of the 400-lb plants is 2,500,000 lb per hr and of the 600-lb plants, including those under construction, 1,300,000 lb per hr. The electrical capacity of the 400-lb powerhouses is about 48,000 kw and that of the 600-lb is about 40,000 kw. In addition, the du Pont Company participates in the operation of the Deepwater Station which serves one of its plants with 400,000 lb of steam per hr and about 10,500 kw net. The throttle pressure is 1200 lb and, in addition to the boiler equipment, there are one 12,500-kw turbogenerator and a battery of evaporators to serve du Pont.

The author defines "high pressure" as not less than 500 psi at the throttle. We first thought that we might submit data to substantiate this definition on other than empirical grounds because we felt that our 400-lb plants were less difficult to manage than the 600-lb plants in regard to such problems as feedwater control, steam purity, and turbine-blade deposits. A more critical examination, however, leads us to believe that this is not the case and that no material difference in operating problems exists between the two pressures. If such is the case we see some prejudicial influence upon the selection of boiler pressures if 500 psi is to be considered as the lower limit of "high pressure." Perhaps it would be better if high-pressure plants were defined as those in which the pressure first exceeded

[11] Chief Engineer, General Foods Corporation, New York, N. Y. Mem. A.S.M.E.

[12] Mechanical Engineer, E. I. du Pont de Nemours & Company, Wilmington, Del. Mem. A.S.M.E.

the old "extra-heavy flanged-fitting standard." This might be taken as 250 psi, or as 300 psi where steel was used.

The use of higher steam pressures for process has made no great progress in our company. In a few instances steam pressures up to 1200 psi are used for process. Generally, these are installations using small quantities and the high-pressure steam is supplied by compressors rather than by boilers. The trend seems to be toward the use of high-boiling-point organic compounds in preference to high-pressure steam, despite the many disadvantages of the former.

The author's statement that all high-pressure engines were installed prior to 1932 is not in accord with our experience. At one 400-psi 700-F plant, we have continued to install engine-driven air and ammonia compressors as the plant expands. The last installation was made in 1939. There are now eight ammonia and four air compressors, the largest engine being 750 ihp. The economy and maintenance of these engines are satisfactory. At another plant we operate engines with 400 psi saturated steam but, when boiler alterations are completed, we expect to use steam with a total temperature of 680 F. The author's figures on installation costs and operating results are in general substantiated by our experience. The operation of an industrial power plant at continuous high efficiency involves a special control technique. The central station, exporting energy only as electricity, can easily measure its performance on the basis of Btu per net kwhr. The industrial power plant which exports energy as electricity, steam at several pressures, and perhaps compressed air and refrigeration, has no such simple yardstick. In the industrial plant the boiler efficiency and perhaps the turbogenerator water rate receive attention but large losses may occur because of poor tactical employment of the several pieces of equipment. We have found that the preparation of performance standards based on the heat balance of the entire plant and giving the over-all dollar efficiency as measured between actual and standard performance results in large savings in the operation of important industrial power plants. This method of control has long been an important tool of management as applied to labor, yields, and the like.

The division of cost between steam and electricity is a perplexing question and ridiculous figures are sometimes used. We cannot agree that standardization of bookkeeping methods is desirable on a national basis. This same problem is faced in many manufacturing operations where by-products are produced and the selling price of such by-products is seldom determined by rational or standardized methods. In dividing cost between exhaust steam and electricity, the writer recommends an arbitrary division which recognizes the prevailing market price of electricity and simultaneously places a price on exhaust steam sufficiently low to encourage its use by the production man but not sufficiently low to encourage its waste.

We agree with Mr. Ryan that boiler feedwater is still the major problem of high-pressure industrial power plants. We look on condensate return from process with greater suspicion than Mr. Ryan indicates and recommend that such return systems be equipped with conductivity meters and suitable alarms. Mr. Ryan has a kind word to say for the evaporative-condenser cycle which we cannot endorse. The evaporator cycle is higher in first cost and very much lower in efficiency as measured by the net kilowatthours produced. We venture the prediction that the progress of water treatment will make the evaporator cycle definitely obsolete within five years. This bold statement is based on estimates recently prepared for a 1200-psi, 20,000-kw station, and on extensive experience with water treatment. Our faith in progress to be made in water treatment is based on recent installations where water very low in dissolved solids has been produced by synthetic exchange mediums and has successfully replaced distilled water in delicate chemical processes.

We are making a typical chemical-industrial approach to the problem of feedwater treatment for 1200-psi boilers. We have already operated a water-treating plant and now have under construction a 1400-psi semiworks boiler to be fed with water from the treating plant. This boiler will be oil-fired with a heat input averaging 100,000 Btu per sq ft per hr. We hope to operate the boiler at this rate continuously for 90 days. The results should be available and we hope to present them to the Society. So far as we have been able to determine, this approach to the problem of the design of industrial high-pressure boilers and water-treating plants is new.

D. S. JACOBUS ADVISES HIGHER PRESSURES FOR ECONOMY

D. S. Jacobus[13] stated: There is no set standard for the best power and steam-generating plant. All of the features which enter the design of a particular plant must be considered, and this is especially so in an industrial plant where steam from a power-generating system is used for process work.

As pointed out by the author, no generalization can be made about the best or the ideal initial pressure for plants supplying industrial steam, and this applies to other elements, such as the degree of superheat, pressure or pressures of the process steam, the boiler feedwater, and the amount of condensate returned from the process.

While it is true that no generalization can be made about the best or the ideal initial pressure, it is customary to employ higher pressures than in the past and, in most cases, this results in a gain in economy.

The equipment provided for utilizing the process steam has an all-important bearing on the economy of the plant as a whole. In addition, the operation of the plant with a given equipment has much to do with the results. In some cases where the process steam is used intermittently, scheduling the work to effect as uniform a consumption of steam as practicable during the working period will effect a material saving. The equipment and the scheduling of the work should be such as to avoid an undue loss in the working time of the operators. Above all, the steam-generating and power equipment must be reliable, since the cost of a shutdown would soon offset a saving through a high thermal efficiency.

The discussion of the problem by the author emphasizes the necessity for experience and knowledge in securing the best design for an industrial plant, as only by experience and by a careful individual analysis can a proper balance be secured between the great number of factors which influence its economy and reliability.

H. W. JOHNSON DESCRIBES MODERN TOPPING INSTALLATION

H. W. Johnson[14] outlined as follows the practice of his company which for many years has generated its own electric power as well as steam for process work: About 1936, new steam-generating equipment was under consideration because of the obsolescence of the plant. Because of the substantial process-steam load, investigation showed that considerable savings could be effected by high-pressure boiler units and a topping turbine.

The old installation consisted of a number of water-tube boilers operating at 165 lb gage (saturated) and three condensing-type turbogenerators. Factory or process steam at 150 lb gage was also furnished by the boilers.

The superposed or topping installation consists of two high-pressure boilers (pulverized-coal-fired), each having a maximum capacity of 55,000 lb of steam per hr, 600 lb gage pressure, 650 F, a straight back-pressure turbine served by the two boilers

[13] Advisory Engineer, The Babcock & Wilcox Company, New York, N. Y. Past-President A.S.M.E.

[14] Assistant Chief Engineer, Celluloid Corporation, Newark, N. J.

and exhausting at 150 lb, serving the condensing turbines and process steam. A reducing station, together with desuperheater is provided to furnish 165-lb steam direct from the high-pressure header when the demand exceeds the exhaust from the topping turbine. This topping turbine is governed by its "tail;" that is, the admission of high-pressure steam is controlled by the exhaust pressure, hence, the machine is kept as fully loaded as the exhaust conditions will permit.

The entire installation has been in operation continuously (24-hr service) except for inspection and cleaning for more than 3 years. The usual difficulties occurred in the early days of operation but it can be positively stated that no serious trouble has developed in either the boiler or generating units which could be attributed to high pressure, design, or operation.

The boilers are kept on the line for periods of 6 months, at the end of which time, they are taken out for cleaning and inspection. The internal condition of these boilers indicates that feedwater treatment is correct since they have been found to be absolutely clean and free from scale with complete absence of any sign of corrosion. In this connection it should be noted that proper apparatus was installed for sampling, the samples being taken by the operating crew and analyzed by the company's chemists.

The topping turbine was opened up after almost 3 years of operation and was found to be in excellent condition.

The predicted economies have been effected and the investment justified. The figure stated by the author of 5000 Btu per kwhr generated by the topping unit is being substantially realized and also the thermal economies in steam generation at high pressures with modern fuel-burning equipment.

Availability of the high-pressure turbine has averaged close to 97 per cent for the period of the 3 years it has operated. This includes the outage for opening up and inspection. Availability of the high-pressure boilers has averaged over 94 per cent including all outage.

A third high-pressure boiler of somewhat larger capacity is now being installed to meet additional demand.

C. E. JOOS DISCUSSES WATER-PURIFICATION PROBLEM

C. E. Joos[15] wrote: The author's statement that water purification and conditioning is still a major problem in connection with high-pressure-boiler operation is not made without due consideration of the facts. While it is true that condensate produced by evaporators is by far the best water supply, this is not always practical due to the cost of evaporators and the degradation of heat they may entail. For industrial plants operating as high as 900 psi, feedwater treatment has been satisfactory even for 100 per cent make-up, in spite of the fact that the raw water available has not been low in solids. As an example of this, the Weirton Steel Company is operating 900-lb boilers with 100 per cent treated water, and the plant has been highly satisfactory, and is now being duplicated. Another recent installation is the Indiana Harbor plant of the Youngstown Sheet & Tube Company, operating at 900 psi, with 100 per cent make-up. In the first case, the treatment method is with the hot-process softener and supplementary treatment; and the second, lime-and-soda pretreatment followed by carbonaceous-zeolite softening.

The development of the art of feedwater conditioning has progressed to the point where the most objectionable solids can be removed and, while silica presented a problem several years ago, its removal at the present time can be accomplished economically.

Coagulations such as aluminum sulphate and ferric sulphate, properly applied in the cold with suitable settling and filtering apparatus, have made it possible to reduce silica concentrations to low values. The objection to this procedure, however, has been the by-product of sodium sulphate produced increasing the solids considerably and necessitating more frequent blowdown.

The use of magnesium salts in the hot-process softener has been very effective in the reduction of silica. Recirculation of sludge has made it possible to cut down the chemical requirements to only a fraction of those required without recirculation.

The use of magnesium oxide instead of magnesium sulphate is a further improvement, in that it eliminates the by-product of sodium sulphate.

Treatment of the water externally to the boilers with phosphate or the use of carbonaceous-zeolite units, reduces the hardness to zero, and in many cases makes it possible to reduce the total solids to very low quantities.

[15] Cochrane Corporation, Philadelphia, Pa.

G. R. KNIGHT GIVES RECIPROCATING-ENGINE DATA

G. R. Knight[16] said: The author's statement that operating temperatures should be made as high as construction materials permit is probably true for those steam plants where turbines are used as prime movers. In steam plants where the prime movers are reciprocating, cylinder lubrication would probably be the limiting feature.

Observations on the two triple-expansion engines at Lockland have shown that satisfactory high-pressure-cylinder lubrication would probably not be possible with steam much above 800 F at the throttle. Tests indicate that, at this steam temperature, the actual ring temperature at the admission end of the piston is about 720 F. While ring and cylinder-liner wear is not excessive, examinations made immediately upon shutting down show only slight indication of oil on the cylinder walls and piston. On the other hand, at 750 F throttle temperature, all parts are heavily coated with cylinder oil.

H. KREISINGER COMPARES INDUSTRIAL AND CENTRAL-STATION PRACTICE

Henry Kreisinger[17] stated: Industrial plants supply power and steam for manufacturing processes, whereas, most central stations generate power only. In industrial plants, the initial steam temperature as usually determined is just high enough to give dry steam from the turbine for process work. In a central station, the steam pressure is selected for the maximum allowable moisture in the lowest pressure stage on the turbine with the highest safe initial steam temperature. The highest safe steam temperature at present is 900 to 950 F, depending somewhat upon the conservatism of the designer of the plant.

The author shows that, in over one half of the high-pressure industrial installations, the initial temperature is under 750 F and, in more than 90 per cent of the installations, it is under 800 F. He points to the possibility of reducing the capital cost by using lower pressures and higher initial steam temperatures. It is true that some of the parts of a lower pressure steam-generating unit would cost less, but the higher initial steam temperature would require a more expensive superheater and a desuperheater to bring the temperature of the exhaust steam near the saturation point. Part of the superheater elements would have to be made of high-temperature and more expensive steel alloy. The superheater supports and spacers would have to be made of more heat-resisting metal which would add materially to the cost of the superheater. There is also the higher cost of high-temperature pipe lines to be considered.

Furthermore, there are some operating drawbacks which

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should be taken into account. Higher steam temperature would require a higher gas temperature entering the superheater. The specific heat of steam is nearly twice that of the gases, so that 100 deg added to the superheat would require about 200 deg higher gas temperature. This means that the superheater would have to be placed nearer the furnace, or the furnace would have to be operated at higher rates of heat release. In either case, there would be a considerably greater tendency for the superheater to become covered with ash or slag. This slagging tendency would have to be taken care of by a more effective system of soot blowers with provisions for hand-lancing. This necessity of keeping a high-temperature superheater free from ash and slag may require additional operating labor and auxiliary steam for soot blowers.

There is also the possibility of reduced steam-generating capacity due to the slagging of the superheater with a shipment of bad coal, and the chances of curtailing factory production. Central stations by going to high initial temperatures are taking less chances because of their interconnection. An industrial plant is usually isolated; it cannot draw steam from outside sources, although it may be able to get outside power. All these factors must be given full consideration in the selection of pressures and temperatures for an industrial plant with the lowest capital cost as well as lowest steam and power cost.

DAVID MOFFAT MYERS SUGGESTS A COMBINATION OF BY-PRODUCT AND PURCHASED POWER

David Moffat Myers[18] declared: Problems of possible by-product power generation often arise in existing industrial plants which are now supplied exclusively with purchased power and whose process or manufacturing steam at perhaps 100 to 200 psi is efficiently produced by a good boiler plant on the property.

In such a case, the most economical program may be a combination of by-product and purchased power. For example, in one such case which the writer has analyzed, two thirds of the total energy required could be secured as by-product from the process steam; using 600 lb initial pressure for a single turbine unit, exhausting into the 150-lb process-steam header. This turbine generator would operate in parallel with the purchased power supply, the latter automatically providing the deficiency during such periods when deficiencies existed. The power company's charge for breakdown service for the entire plant would be little or nothing, since the guaranteed monthly payment would be considerably less than the average monthly bill under this arrangement.

The operating savings would return the investment in about 3 years. Only one new high-pressure boiler and one new turbine would be called for under this program, thus keeping capital expenditure at a low level. Nevertheless, 100 per cent emergency reserve would obtain for the electrical requirements as well as for process steam, the latter being provided for by the old 150-lb boilers.

R. C. POWELL FEELS DUAL-PURPOSE PLANTS HAVE ADVANTAGES

R. C. Powell[19] wrote: The successful application of high-pressure and high-temperature steam has stimulated the development of dual-purpose plants so that in many cases the amount of power available in connection with the process steam is greatly in excess of that required by the industry. However, maximum power development is difficult or impossible for the industrial plant because little, if any, profitable market exists for the excess by-product power.

In Table 4, the author gives data for plants which are obviously not representative of plants for maximum power output which can be built today. The figures given for gross kwhr per M lb steam generated and net kwhr per M lb steam delivered, are 31 and 32, respectively. For a plant operating at 1400 lb throttle pressure, 940 F, delivering process steam at 160 lb, the corresponding figures are 54 and 67.

The comparative figures for total quantities of steam, kw and kwhr are, in round numbers, taking the steam to process as the same in both cases:

	As given	High-pressure plant
Steam delivered, billion lb per yr	15	15
Steam generated, billion lb per yr	15	20
Delivered steam maximum demand, million lb per hr	2.3	2.3
Kw	77,000	157,000
Kwhr, millions per yr	458	1000

Will the author give additional figures showing the power exchange, if any, between this group of plants and the utilities or other industrial plants, as this, perhaps, will emphasize the relation of steam-and-power usage and excess by-product power available.

It is undoubtedly safe to say there are, in this country, many possibilities for dual-purpose plants which can be built for the maximum economic gain only in connection with utility operation, and the most economical plant will be one which is different from the usual utility practice only in so far as modification is necessary for the output of steam.

The installation of dual-purpose plants by utilities, in many cases, will appear attractive both to the utilities and to industry since over-all costs will be reduced as against operating separately, but there are risks to the utility arising from the possible changes in industrial processes which may occur in the comparatively long time required for the utility to amortize its investment. As an example, some large cane-sugar refineries (which are large users of steam with very favorable load characteristics) have, in the last few years, greatly reduced operations and the pickup by new beet-sugar refineries has been at other locations.

These risks may be so reduced that industry can afford to protect the utility against any reasonable loss if the industry is a basic one operating at high load factor, and the location is reasonably good as a generating point (regardless of whether steam is supplied or not) for power, perhaps 50 per cent greater than the initial capacity. Then, if the industry or its use of steam should fail, an additional condensing turbine at small cost will convert the plant to one for complete condensing operation.

If, in addition to the foregoing requirements, the industry has fuels which are waste or difficult to handle or market, the economics are considerably better for both the utility and industry. Two such industries are oil refining and lumber mills.

C. J. SIBLER'S COMPANY HAS PIONEERED IN HIGH-PRESSURE WORK

C. J. Sibler[20] stated: The writer's company has been a pioneer in the use of higher-pressure steam for industrial plants. In fact, by the end of this year every one of its six paper mills will be operating at 600 lb pressure, with a total steaming capacity including spare high-pressure equipment of approximately 3,000,000 lb per hr, and turbine-generator capacity in excess of 100,000 kw. With proper balancing of turbine equipment, taking advantage of bleeding for process and supplying warm water for the paper mill, power-plant efficiencies as high as 65 per cent have been obtained (exclusive of boiler losses), and the limit has not been reached.

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[19] Pacific Gas & Electric Company, San Francisco, Calif.
[20] Supervisor of Power, West Virginia Pulp & Paper Company, New York, N. Y.

Steam temperatures have been kept inside of conservative limits, not in excess of 720 F, determined by the temperature desired for process steam. While there may be useful applications for higher temperatures and applications of thoroughfare desuperheaters, it should be in order to move rather cautiously in that direction.

With the advent of high-pressure steam-generating units in industrial plants operating at high ratings, operating problems have greatly increased. No doubt all of these can be solved satisfactorily, but they certainly bear watching. As the author points out, the industrial-power engineer is dealing in most cases with a boiler water which is partly or mostly treated make-up and, under such conditions, proper circulation in the boiler and means to produce clean steam require careful study. When operating costs, in particular, maintenance and repairs, as well as loss due to outage, are considered, conservative design, even though entailing larger first cost, pays good dividends in the end. The author's investigations indicate that this trend seems to be followed in the case of industrial plants more than with public-utility installations where pure condensate is available almost exclusively. With proper treatment of the boiler feedwater, both externally and internally, scaling of the heating surfaces is no problem; and, with the gradual disappearance of the reciprocating engine in large plants, the feed can be kept oil-free.

High availability of steam- and power-generating equipment is a direct result of design, and the point cannot well be overstressed that reduction in installation cost should not be brought to a point where reliability is jeopardized. Capital charges and production and maintenance costs should therefore be properly balanced out.

Where process steam is required, but power could be purchased from an outside source, the latter when generated in a high-pressure plant should only be charged for the heat absorbed in the turbine plus that going to the condenser, properly corrected for boiler efficiency and auxiliary losses. The power should also carry all the fixed charges, resulting from additional investment in the high-pressure steam-and-power plant over that of a low-pressure steam plant, sufficient to supply the necessary process steam. The cost of the heat used for power production should be figured as its portion of the total heat used for power and process. Such a rule should be applicable to all but exceptional cases.

One point that may be stressed is the advisability of designing the plant for the greatest variety of fuel available in the district. The writer's company now has under construction the largest installation in which pulverized anthracite will be burned under the unit system, with bituminous coal and oil as secondary fuels.

E. S. WELLS, JR., SUGGESTS PLANTS OF EXCESS CAPACITY

E. S. Wells, Jr.,[21] commented as follows: The data presented by the author should serve to remove any doubt from the minds of those who have hesitated to obtain the benefits of higher pressure and temperature for power generation because of anticipated operating difficulties. The installation-cost figures, while covering a fairly wide range, should also be of considerable interest to those contemplating this type of plant. While bookkeeping systems vary, the fact remains that power generated from process steam requires heat consumption of not over 5000 Btu per kwhr.

The type of plant in which power demands are in excess of what can be generated at "moderate pressures" warrants the added expense of high pressure or high temperature, or both, to increase power generation. The author's suggestion of considering pressure and temperature together is eminently worthwhile and has often been overlooked in the past. The problems due to treated feedwater at high pressures may prove to make high temperatures relatively more desirable.

There are undoubtedly many industrial plants where power demand is so small in relation to steam demand that power generation is incidental and only the simplest kind of a plant could be justified. However, industrial processes change, sometimes with considerable rapidity, and in recent years the tendency has been for power demands to increase faster than steam demands. A selection of boiler pressure and temperature which seemed at the time adequate to give a comfortable margin of power generation over the probable demand has often been found, within relatively few years, inadequate to give the increased power generation required under new conditions. For this reason, it would seem wise to select boiler pressures and temperatures such as to give as much margin as possible in power generation over power demands without, of course, incurring excessive costs.

F. L. BRADLEY COMPARES A HIGH- AND A LOW-PRESSURE PLANT

F. L. Bradley[22] wrote: The report of progress of higher pressures in the industrial plant provides reassuring data to the industrial-power engineer who may be engaged in the analysis of this specific problem. The availability figures for both steam- and power-generating equipment are especially pertinent.

Comparing operation of two power plants built in 1932, one operating at 250 psi, the other at a pressure just under the author's lower limit, the writer has experienced no difficulties due to higher pressure demands. Feedwater treatment is essentially the same in both plants and each plant has approximately 60 per cent make-up. Examination of the steam-generating surfaces and turbine blading showed these surfaces in both plants to be equally free from scale and deposits.

The probable power changes that often develop in a plant after a few years of operation should be given careful consideration in the selection of pressure and temperature. A provision for a margin of power generation over the contemplated demand is a prudent precaution in the initial design of any high-pressure installation and, in the writer's opinion, can be justified economically.

This paper also reaffirms the need for standardization of cost records. Although any movement in this direction would present obstacles, it would be well worth the effort. This is a study worthy of the attention of a special subcommittee.

S. B. APPLEBAUM GIVES TECHNIQUE OF FEEDWATER TREATMENT

S. B. Applebaum[23] discussed the paper as follows: Undoubtedly progress in high-pressure power-plant design would not have been possible if corresponding progress had not been made in the technique of boiler-feedwater treatment. Among the outstanding achievements of recent years in feedwater treatment may be mentioned the following:

1 Improved secondary internal treatments to inhibit corrosion, deposits, and embrittlement.

2 Precipitators for more efficient cold-lime treatment, as well as coagulation by contact with sludge.

3 Improved deaeration to produce zero-oxygen water, using atomization or scrubbing by steam instead of trays.

4 Carbonaceous zeolites, especially hydrogen zeolite.

5 Silica removal by ferric sulphate and more recently by the dolomitic-lime process.

6 Anion removal.

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SECONDARY TREATMENTS

A number of secondary treatments have been developed which have been helpful. Among the more important of these are:

a Phosphates for scale prevention. It is customary to maintain a reserve of excess PO_4 in the concentrated boiler saline so that in case any hardness contaminates the feedwater by condenser leakage or other channels, this PO_4 reacts with the hardness to form phosphate sludge.

b Certain iron compounds to coagulate scale-forming matter and to absorb silica in the boiler.

c Sodium sulphite to react with oxygen and prevent corrosion.

d Tannin to coagulate scale-forming matter and react with oxygen.

e Lignins to inhibit intercrystalline corrosion. This has been the result of research work of the A.S.M.E. Committee on Embrittlement and the laboratories of the Bureau of Mines.

PRECIPITATORS

External primary treatments frequently include addition of coagulants for clarification of muddy waters as well as lime for reducing carbonate hardness. Hitherto it has been standard practice to mix the chemicals and the water together for a very short time and then settle the water. The precipitates formed settled out. The settled water was then filtered. More recently, especially due to the research work of C. H. Spaulding, chemist at Springfield, Ill., recognition has been given to the value of the sludge in improving the reactions. The Spaulding precipitator has been developed to keep the precipitates in suspension by mechanical agitation rather than to allow them to settle. After about thirty minutes in this agitating zone, the water passes upward through another zone containing a suspended sludge blanket of the precipitates and separates from the blanket by decreasing velocity. Clear water emerges from the top.

The concentration of sludge in the blanket is controllable by regulating the desludging which is now made automatic. By having high enough concentrations of sludge, absorbent effects, such as removal of silica, have been made possible which were hitherto unknown.

Smaller basins, clearer and more stable water and saving of chemical have been accomplished by this long contact period with sludge.

IMPROVED DEAERATION

Deaerators have been improved so that the effluent has zero oxygen. This has been accomplished by more thorough contact of steam and water. Two types have also been developed which eliminate trays; these are the atomizing type and the scrubber type. The water is first preheated by a spray heater. This reduces the oxygen content to a fraction of 1 ppm. The preheated water is then brought into intimate contact with pure steam for final deaeration. The preheated water is so hot that very little of the pure steam is condensed and therefore the steam does a good job of scrubbing out the dissolved gases. The steam after scrubbing rises to the preheater to heat the incoming cold water.

CARBONACEOUS ZEOLITES

This is the latest type available to industry. It has not replaced the older siliceous zeolites, but it has made a place for itself because of three new properties:

1 It produces a water of 0 to 2 ppm hardness in either the hydrogen or sodium cycles, i.e., being regenerated either by acid or salt. In the hydrogen cycle, besides removing hardness, it removes alkalinity by changing bicarbonates to carbonic acid, which is then removable by mechanical degasification.

2 It can remove sodium bicarbonate from water. Previously no chemical method was available for this purpose.

3 It can soften waters low in silica without the danger of silica pickup from the zeolite itself.

Reduction of alkalinity simultaneous with hardness is important because low alkalinity has the following advantages:

1 The production of drier steam, i.e., of higher quality.

2 The saving in boiler blowoff due to lower total solids in the feedwater.

3 Reduction in corrosion at "hot spots" in boiler tubes.

4 Lower CO_2 content in the steam and therefore reduction of corrosion in condensate lines.

One of the most recent large carbonaceous-zeolite plants installed is at the Waterside Station of the Consolidated Edison Company, New York City. This treats New York City water and reduces the hardness from 35 to 44 ppm down to 0 to 3 ppm. It reduces the alkalinity from 32 ppm down to 4 ppm and therefore eliminates nearly 90 per cent of the potential CO_2 in the steam. This is important in this case because about 25 per cent of the steam generated passes out into the steam mains of the New York Steam Corporation. The boiler pressure is 1250 psi and the make-up will be 1,200,000 lb per hr.

Primary external treatments now generally employed for high-pressure plants consist either of:

1 Hot-process lime soda with or without phosphate external treatment as a second stage;

2 Carbonaceous sodium zeolite with or without acid feeds;

3 Carbonaceous hydrogen zeolites plus alkali feed or Sodium Zeo-Karb (carbonaceous sodium zeolite); or

4 Lime pretreatment followed by recarbonation or acid feed followed by carbonaceous zeolite.

To determine which of these treatments is most suitable in any given case it is necessary to make a study of the analysis of the raw and treated water, the operating cost, and the fixed charges.

SILICA REMOVAL

The Stone & Webster Engineering Corporation has been active in promoting research in silica removal because it has been found that silica in the boiler saline causes silica scale, especially in hot spots and silica deposits in turbines by carry-over. Dr. Schwartz at Baton Rouge under the encouragement of this company has done very helpful research work in the use of ferric sulphate in coagulating silica.

More recently research work in the use of magnesium compounds for that purpose has been carried out. Magnesium hydrate absorbs silica just as ferric hydrate does. But the amount of ferric sulphate required rises rapidly with the silica content and, therefore, the operating cost is high and the resulting total solids high due to the sulphate anion left in solution. Magnesium compounds free from sulphate anion overcome these objections.

In the search for a source of magnesium which is economical, the use of dolomitic lime was considered. Obviously if the magnesium oxide in this impure lime could be utilized it would be very inexpensive. Our research work shows that this is practical. The MgO in the dolomitic lime acts in two ways to absorb the silica:

a By contact as an unprecipitated suspension especially at high concentrations in a sludge blanket of a precipitator.

b By contributing soluble or ionic Mg to the incoming water. This is accomplished by withdrawing the sludge from the precipitator continuously and bringing this sludge into contact with carbonated or acid-treated raw water. At the pH

used, the sludge gives up its MgO but not its $CaCO_3$. The increased ionic Mg content of the water is then precipitated by the addition of the dolomitic lime to the precipitator.

One large plant is now using this process in the first stage (using suspended MgO), reducing the silica from 5 to 9 ppm in the raw water down to 2 to 3 ppm and handling about 3000 gpm. Other plants are expected to be in operation shortly.

ANION REMOVAL

Finally, the production of a water free from almost all solids by external primary treatment is rapidly approaching realization.

This "demineralizing" process consists of 2 stages:

a Carbonaceous hydrogen zeolite to exchange hydrogen for the cations Ca, Mg, Na, etc., and thus produce a water containing only acids, H_2SO_4, HCl, H_2CO_3, etc.

b Special organic material such as "Deacidite" to absorb these acids and thus produce a water practically free from these cations and anions.

A number of two-stage plants of this type are now in operation for purposes which hitherto utilized distilled water.

R. E. HALL DISCUSSES WATER CONDITIONING

R. E. Hall[24] stated: With sufficiently constant coverage of the boiler evaporative surfaces with water, i.e., the surfaces of boiler tubes, waterwalls, or floor screens, deposition of scale or deterioration of the metal by pitting or cracking is prevented by maintaining rather easily established conditions in the boiler water. These comprise alkalinity, defined by pH value of perhaps 9.5 as a minimum to 11.3 as a maximum, although higher alkalinity can be tolerated, if necessary because of considerable suspended material in the boiler water; unspent phosphate of a few parts per million; at these higher pressures, sodium sulphite is probably best as an oxygen scavenger. From the research work sponsored by the Boiler Feedwater Research Committee, comes the embrittlement detector, operation of which, in conjunction with the boiler, serves as a guide to any further requirements in water-conditioning work to provide protection from embrittlement.

Once these several factors are synchronized, it does not matter a great deal whether the operating pressure of the boiler is 600 or 1600 psi or higher, except that higher pressures mean higher temperatures, and chemical reactivity is accelerated rapidly by the latter.

The different phases of corrosion and cracking have been discussed in detail in a paper[25] by Partridge and Hall; the problem of zeolitic scale when make-up is treated water, in a paper[26] by Hall, Partridge, and Daugherty.

Channeling corrosion or cracking may occur, even though deaeration of water entering the boiler may be as complete as mechanical skill can make it. This is not surprising because, although the oxygen *dissolved* in the feedwater may be nil, yet every 100 lb of that feedwater is made up of 88.9 lb of oxygen and 11.1 lb of hydrogen. All that is necessary to make that oxygen available for corrosive action is to provide conditions which will permit the iron to split the oxygen from the hydrogen. The author speaks of the extremely high rates of heat input into the furnaces of these recent boilers. Where a surface is not sufficiently continuously covered with water, that high rate of heat input sets up favorable conditions for the cleavage of hydrogen and oxygen, and corrosion proceeds apace. Temporizing with such a condition is possible by maintaining the pH value of the boiler water at a quite low value, such as 9.5, thus avoiding the formation of strong caustic films where water evaporates well-nigh to dryness, and the aid which they can give either to corrosion or to intercrystalline cracking. The low pH value, however, promotes the risk of transcrystalline or corrosion-fatigue cracking, especially in tubes where rapid alternation of steam and boiler water occurs.

When treated water is used for make-up, and certain areas are lacking in continuous enough coverage by water, corrosion or cracking may occur. However, sodium-aluminum-silicate may be deposited as a scale over the surfaces, which prevents the corrosion or cracking, but injects the possibility of failure by burning-out in the usual manner. In this case, also, the maintenance of steady coverage of the surfaces by water, either by more circulation, by specific means introduced into the tubes themselves, or by better steam-relieving capacity, eliminates the condition.

C. H. GREEN DESCRIBES 900-LB PLANT OPERATION

C. H. Green[27] discussed the paper as follows: Operation of the Richmond 900-lb 750 F by-product power plant, since it went into full operation in January, 1937, has been quite satisfactory. There has been but one complete outage during this period. This was of momentary duration and was due to an operating error. On two occasions one generator has tripped off the line, and there have been a few cases of severe voltage dips due to line and cable trouble external to the plant. In each case a portion of the load has been dropped as the result of operation of undervoltage devices and other protective equipment, but refinery operations have not been seriously interfered with at any time.

The Richmond plant consists of three 900-lb, 760-F total temperature 125,000-lb per hr boilers and three 5000-kva turbogenerators, together with a water-treating plant of sufficient capacity to supply full boiler requirements. Each boiler is equipped with five burners, two of which burn either natural gas, refinery-process gas, or heavy fuel oil, and the other three, gas, fuel oil, or refinery acid sludge. Normally two boilers operate at fairly close to their rating and the third floats on the line, producing about 40,000 lb per hr. Three sludge fires and two gas or oil fires are carried on each of the former, and two oil or gas fires on the latter. Load fluctuations are taken by the gas or oil fires, the sludge being burned at as constant a rate as possible. Each boiler is shut down for a general inspection and cleaning every 6 months, after generating approximately 350,000,000 lb of steam. In addition, at about the mid-point of the run, it is shut down for a short time for superheater washing and for removal of slag from the heating surfaces. This slag results from the burning of oil and sludge simultaneously, and does not appear in appreciable quantities when gas is used instead of oil. The average availability of boilers when burning gas and sludge is 82 per cent and when burning fuel oil and sludge is 75 per cent. Tube failures have not been such as to interrupt service to the refinery. Two superheater tubes failed about a year ago during a test run made to determine if it would be possible to shorten the washing period. Both of these failures were localized to such an extent that it was possible to repair the tubes in place. One waterwall tube failed recently, apparently due to the formation of thin scale at a point near the bottom of the furnace. The cause of the scale formation is believed to have been determined and eliminated.

Approximately 76 per cent of the boiler feed is treated water, the balance being condensate from the deaerating and high-pressure feedwater heaters. The raw water averages 30 ppm

[24] Director, Hall Laboratories, Inc., Pittsburgh, Pa. Mem. A.S.M.E.

[25] "Attack on Steel in High-Capacity Boilers as a Result of Overheating Due to Steam Blanketing," by E. P. Partridge and R. E. Hall, Trans. A.S.M.E., vol. 61, 1939, pp. 597–623.

[26] "Routing Nightmares of Water Conditioning," by R. E. Hall, E. P. Partridge, and T. H. Daugherty, MECHANICAL ENGINEERING, vol. 61, 1939, pp. 715–721.

[27] Standard Oil Company of California, Richmond, Calif.

hardness and 11 ppm silica. The silica is reduced to 3 ppm by the ferric-sulphate coagulation process and the water is softened in base-exchange softeners. The results obtained with this treatment have been quite satisfactory. All operations and routine control tests are performed by regular plant operators (not technical men) and in addition the services of a refinery chemist are required about five hours a day to make check tests.

The main turbines operate with steam at 825 lb, 750 F at the throttle and exhaust into the refinery steam system at 120 lb, 40 F superheat. The heat requirement per kwhr delivered to the bus is 4860 Btu. The average availability is 90 per cent. Since this one plant supplies the entire refinery electric requirements, and no relay supply is available from any outside source, every effort is made to keep all units, both boilers and generators, in first-class condition and on the line as great a proportion of the time as possible. Some load scheduling is necessary when a boiler is down for cleaning or repairs and only two are operating, but so far this has caused no serious inconvenience.

Electric energy is generated at 2400 v. The maximum net output from the station to date, exclusive of station auxiliaries, has been 9850 kw. The average monthly system load factor is 82 per cent and the power factor 0.86.

Plant auxiliaries are partly steam and partly electric drive. The boiler feed and induced-draft fans are motor-driven. The fuel-oil pumps are motor-driven with steam stand-by and the acid-sludge pumps are steam-driven. There are three boiler feed pumps, any one of which is capable of supplying the full load requirements of all three boilers. One is motor-driven and one is turbine-driven, taking steam at 120 lb and exhausting either to the 10-lb system or to the atmosphere. The third, which is the unit normally used, is driven by a turbine which takes its supply either from the 120-lb or 10-lb system, or from a combination of the two, and exhausts to a condenser which uses the boiler feedwater on its way from the softeners to the deaerating heater as a condensing medium. The balance between the amounts of steam taken from the 120-lb and 10-lb systems is maintained by a governor actuated by the vacuum at the turbine exhaust. This is made necessary by the fact that operating conditions in the water-treating plant, which control the rate of flow of the condensing water, do not vary in step with the boiler-feed requirements.

Aside from several experienced supervisory operators, borrowed during the breaking-in period, all plant operators have been drawn from the regular refinery force. These men have shown themselves fully competent to operate a plant of this type, and their knowledge of the operation and power requirements of the various consumers throughout the refinery, gained during their years of service here, has been of considerable benefit when scheduling load and during emergencies.

AUTHOR'S CLOSURE

The volume of discussion of this paper indicates clearly the interest in the subject of high pressure steam for industrial power, but it also makes it impossible to deal adequately with the many questions raised.

The cautionary remarks with regard to high temperature are well taken; the intent of the paper was to emphasize the inherent possibilities which are sometimes overlooked. The general agreement that the present technique of water purification is capable of producing suitable feedwater for high-pressure boilers is in line with the author's experience, but does not affect the conclusion that it is usually the most difficult problem encountered in the design and operation of high-pressure industrial power plants.

The author is particularly gratified by the data presented on construction costs, operating expense, availability, and efficiency. In all cases these data are within the limits derived from the original paper, although the reported availability factors are uniformly higher than the average derived from the author's data. In general, the data which are presented in the discussion are confirmatory, and indicate that existing plants are highly satisfactory with respect to reliability and production costs.

W. F. RYAN.[28]

Frozen-Earth Dam at Grand Coulee

(*Continued from page 15*)

cover the total cost of installing, operating, and dismantling the refrigerating system.

Labor, including industrial insurance and social security tax:	
Plant operation (9812 man-hours)	$10875.20
Installation and dismantling (8798 man-hours)	10640.67
Machinery rental, including use of small tools	9031.73
Materials	15958.77
Electricity (278,600 kwhr)	1952.45
Total, including 10 per cent	$48458.82

To the account of the frozen dam may be credited the saving of 30,000 yd of excavation in the deep ravine at a cost of $1 per yd. Had the ravine been excavated there is no doubt but that the cracks which extended across the western sector of the forebay slope would have developed into an additional slide and endangered the east end of the upstream cofferdam extending across the Columbia River. The value of the frozen dam in the latter respect probably is far in excess of its value in the direct saving in excavation.

CONCLUSION

The total refrigeration, spacing between refrigerating points, and the freezing time proved to be in such excellent agreement with the initial estimates that no modifications are suggested in this respect.

In the design of refrigerating points, the welding of all points to be driven in the earth is recommended. Welding should practically eliminate all leaks and make feasible the use of calcium-chloride brine. Lower temperatures could then be maintained which would result in greater strength of frozen material.

The location of the frozen area should, if possible, be sufficiently removed from the main excavation so that a slope of earth would remain against the frozen surface and serve to insulate it against the warmth of the atmosphere.

The use of refrigeration as a tool of construction will doubtless have a very limited application. Its cost precludes its use except in unusual cases where the freezing of a strategic area is possible.

ACKNOWLEDGMENTS

The Grand Coulee Dam is a feature of the Columbia Basin project being constructed by the United States Bureau of Reclamation under the direction of John C. Page, commissioner; R. F. Walter, chief engineer; and Frank A. Banks, supervising engineer in responsible local charge. The writer, under the immediate direction of construction engineer A. F. Darland and associate engineer Grant Gordon, assisted in the design, installation, and operation of the refrigeration plant and accessories.

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THURMAN ARNOLD *on the* SHERMAN ACT[1]

By RICHARD CLEMENCE

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THE rapid growth of big business in the United States in the period following the Civil War gave rise to new problems of regulation and control. The ineffectiveness of local attempts to define and apply the ancient common-law doctrine that restraints of trade are contrary to the public interest led to the passage by Congress of the Sherman Anti-Trust Act in 1890.

The Sherman Act states that "every contract, combination in the form of a trust or otherwise, or conspiracy in restraint of trade or commerce among the several states, or with foreign nations, is hereby declared to be illegal." The Attorney General is given the authority to institute proceedings in equity to dissolve trusts or restrain them from violation of the act; anyone injured by practices forbidden by the act is entitled to sue for triple damages; and also to be noted, the act is a criminal as well as civil statute, and any person convicted of violating its provisions is liable to a fine not exceeding five thousand dollars, or imprisonment not exceeding one year, or both.

The application of the Sherman Act resulted in a series of Supreme Court cases whose euphonious names are more or less vaguely recalled by all those who have studied American history and economics. If, in the student's memory, some haziness surrounds the history of prosecutions under the Sherman Act it is not surprising. The matter was very much confused by differences of opinion as to the proper field for application of the act, and by changing views on the part of the Supreme Court as to its interpretation. In general, it was aimed more directly at size than at inefficiency, and this made it necessary to invoke the "rule of reason" in applying the act to industrial combinations; for achievement of the economies of large-scale production was obviously in the public interest. Public enforcement of the Sherman Act was a failure because it was really never seriously attempted. The trust-busting of Theodore Roosevelt looks in retrospect to have been more largely associated with political expediency than has been generally recognized. It is difficult to take it very seriously when we consider the fact that the entire personnel of the anti-trust division at that time consisted of but five lawyers and four stenographers. The U. S. Steel case also showed pretty clearly which way the wind was blowing. Since criminal penalties were seldom invoked, the real teeth in the law turned out to be the triple damages provision. This had the unfortunate effect of leaving enforcement in private hands to be used for private purposes, and the act was thus turned against labor unions, and likewise used as a threat by certain firms to their competitors. The result of these uses of the law was to relegate the interests of the consuming public to a secondary position where they were served only incidentally at best.

Since 1933, there have been two distinct phases in the history of the Sherman Act. When the New Deal administration came into office early that year, this country was in the midst of a severe business depression in which the price system seemed to be contributing somewhat less to human welfare than the classical economists had led us to expect. Under the circumstances action might take one of two forms. Either the forces of competition could be freed of certain obvious restraints in order that they might work in closer conformity to expectation, or direct measures might be exercised to secure a comparable result with less delay. The second alternative appeared more attractive at that time, and it was adopted with high hopes and elaborate machinery, an important part of which was the N.R.A. During the next two years the Sherman Act was generally regarded as obsolete, though as an important bit of the folklore of capitalism it was mentioned in the National Recovery Act and permitted to remain on the statute books. Then, in the Schecter case of 1935 the N.R.A. was declared unconstitutional by a unanimous decision of the Supreme Court. Though many economists would say now that the N.R.A. served a very useful purpose by supporting inventory values at a critical time, it had clearly outlived its usefulness to the public at large and the Schecter decision was a popular one.

Although faith in the planned economy was not wholly extinguished by this unfortunate experience, it became clear that a different line of attack would be necessary, and the idea of enforcing freer competition was hit upon. The Sherman Act was dusted off, and an expert on capitalist folklore was found in the person of Prof. Thurman Arnold of Yale. Mr. Arnold became assistant attorney general in charge of the anti-trust Division, and he began at once a vigorous program of anti-trust law enforcement. He has just written a book[2] setting forth his philosophy, and explaining what he is trying to do, and how he is doing it. It is a book which anyone with either a personal or academic interest in the present relations between business and the government would do well to read. The methods by which the anti-trust division proceeds against restraints of trade with many interesting examples of the results following upon prosecutions under the Sherman Act, an explanation of the arrangement under which businessmen contemplating any particular combination may protect themselves against the liability to criminal prosecution under the Sherman Act, and a discussion of the place of anti-trust enforcement in the national-defense program, are features of the book which cannot well be summarized and which make it interesting and important reading. In place of any attempt at summary it therefore seems best to make certain comments concerning the more fundamental questions which Mr. Arnold's book appears to me to raise.

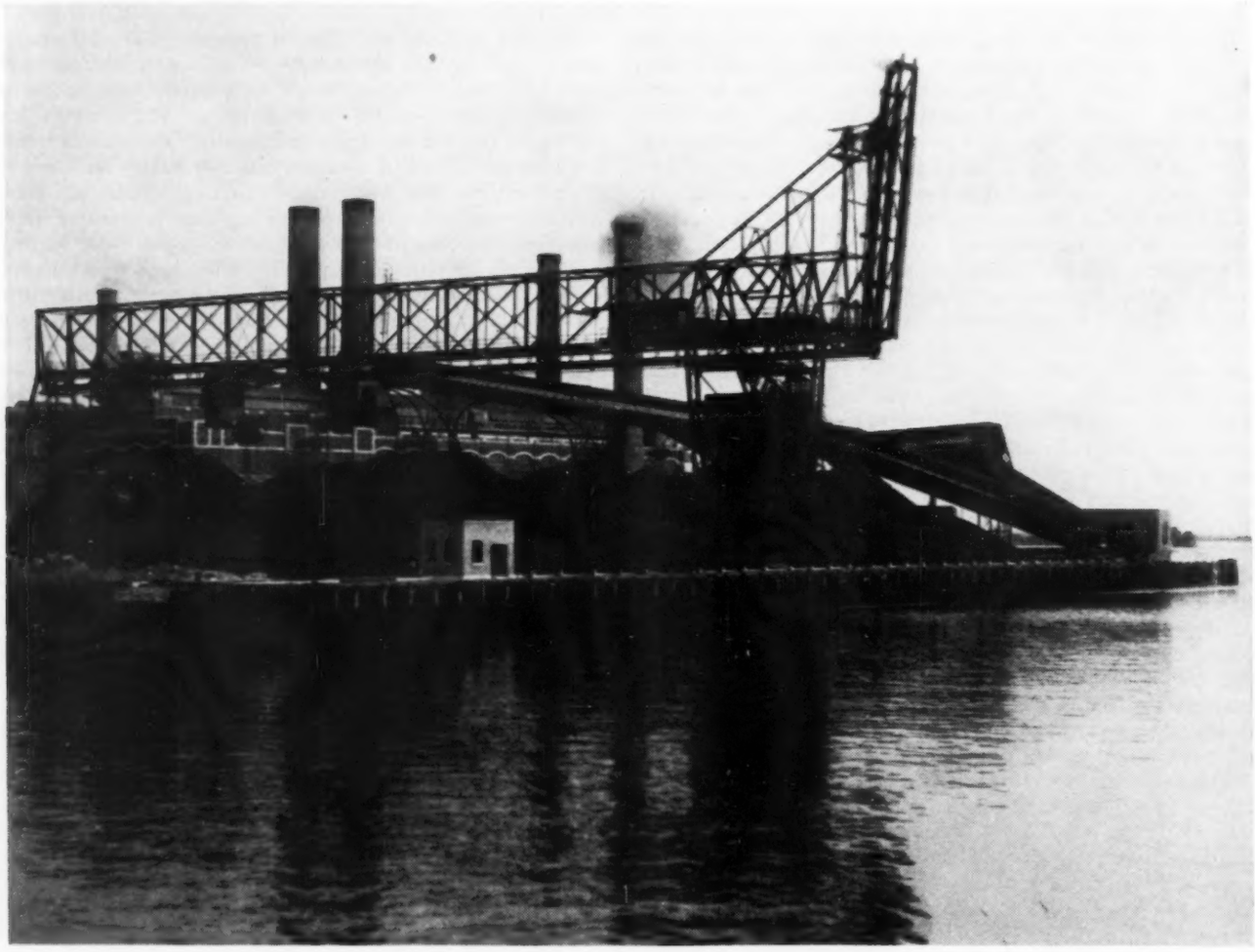
Thurman Arnold is firmly convinced that not only the welfare of the consuming public, but the very existence of political democracy depends upon the maintenance of free markets. Restraints of trade lead to industrial concentrations of power without public responsibility, and self-regimentation by business which results in the exploitation of consumers must lead eventually to state control and political collectivism. Such has been the course of events in European countries like Germany and Italy, and Mr. Arnold warns that there is danger of similar developments here. This is one of the most significant issues raised by the book, and I think Mr. Arnold's thesis an entirely defensible one.

[1] One of a series of reviews of current economic literature affecting engineering, prepared by members of the department of economics and social science, The Massachusetts Institute of Technology, at the request of the Management Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Opinions expressed are those of the reviewer.

[2] "The Bottlenecks of Business," by Thurman Arnold, Reynal & Hitchcock, New York, N. Y., 1939.

Less sound appears to be his contention that restraints of trade account for "the unbalance of prices which has been the principal cause of the failure of our economy to get on its feet in the last eight years." Business cycles are not to be eliminated simply by enforcing freer competition. We have had severe and prolonged depressions in the past, although they do not show very well on the chart Mr. Arnold presents (page 6). The great depression of the 1840's lies just off the chart toward the west, and the other comparable one in the 1890's is hidden somewhere beneath the ten-year average line which is drawn through that period. To bring out such comparisons a chart of this kind might better be drawn on a ratio scale, because otherwise depressions look worse and worse as the national income increases simply because the absolute fluctuations are greater, whereas they may be no more serious relative to the prevailing income level. So it is not established that increasing restraints of trade have brought about deeper and longer business depressions, or that enforcement of the Sherman Act would end cyclical depressions in addition to producing more obvious benefits. This is merely to point out that the undoubted advantages to consumers in the way of lower prices following the breaking down of restraints of trade does not mean that anti-trust enforcement can perform miracles, and we should base our decisions regarding the desirability of such enforcement on a less optimistic view as to its possible effects.

Finally, a word should be said concerning the Sherman Act and the defense program. Evidently restraints of trade greatly increase the costs of rearmament, reduce efficiency, and result in bottlenecks at critical points which may endanger the success of the whole undertaking. Now, whether we like it or not, we are apparently committed to competition with the totalitarian nations in the one field in which they are most competent. The seriousness with which we must pursue this project varies directly with the successes of our rivals in the present conflict, and we are likely at any time to find ourselves in a grave situation in which all other interests must be subordinated to the single end of winning the race we have entered. It takes time to remove restraints of trade by due process under the Sherman Act, and there is good reason to expect that due process would be discarded in favor of some kind of more forceful measures if this sort of bottleneck should seriously delay the progress of the defense program. Thurman Arnold believes that with an adequate staff and public support the anti-trust division can clear obstructions from the channels of trade and make less pleasant procedures unnecessary. "The Bottlenecks of Business" may be regarded as an appeal to the people of this country to endorse the new program of enforcement of the Sherman Act, and it behooves us all to give consideration to the case he submits and make up our minds whether or not it deserves our support.



POWER IN THE MAKING

(Photograph taken by W. E. Wollheim and shown at the Fifth Annual Photographic Exhibit held during the A.S.M.E. Annual Meeting, Dec. 2–6, 1940, New York, N. Y.)

To A.S.M.E. Members:

THE COUNCIL REPORTS FOR 1940

OCTOBER 1, 1939, the opening day of the sixtieth-anniversary year of the Society, followed on the heels of the declaration of war in Europe. The year has brought forth daily concern about military events in Europe and China, daily discussion about the proper policy for defense of the United States and the immediate need for trained men and equipment, and increasing desire by engineers to aid in all the efforts of our government toward defense.

With the appropriation of defense billions in June and September, the problems of the procurement and production of war materials became pressing, and as the year drew to a close, the industry of the nation was striving manfully to divert its peacetime skill to the manufacture of ordnance, aircraft, and other war supplies. In this shift, the members of the Society are playing important parts and as it becomes effective, they will play still more important parts in production of war materials as well as in the armed services.

The Society as a body has rendered conspicuous aid to the national defense. During the entire period since the first World War its public forums have been devoted to the cause of industrial preparedness. During the last year, in national and local meetings, the problems of war design and production have been taken up and in particular two meetings on shell manufacture have proved of tremendous value in the initiation of the shell program. The National Defense Committee of the Society has been enlarged and the members are making themselves available to lead the discussion of national-defense problems throughout the country. Special study groups have been organized for particular problems and the Society is giving special attention to its standardization and research activities which will be of value to national defense. The Society is rightfully proud of its accomplishment in support of national defense and is looking forward to a period of great further usefulness.

Within the fabric of industry, concerned about national defense and busy with production, the Society carried on a most successful year. Before considering a summary of its activities, it may be well to recall a few salient facts about the Society. It has 14,846 members, 70 Local Sections, and 16 Professional Divisions. Some 2500 members are active in 500 committees on research, standardization, and codification. In addition, over 6000 Student-members participated in 117 Student Branches.

In the following paragraphs, the work of the year will be presented under three principal headings: I—Promoting Mechanical Engineering; II—The Engineering Profession; III—Administrative Matters.

I—PROMOTING MECHANICAL ENGINEERING

In an art and science as well developed as mechanical engineering, the spectacular development is relatively infrequent. Progress comes from steady small advances. In this progress, the Society makes its contribution by providing opportunities for its members to meet and discuss their advances, to work together to make joint advance through research, and to consolidate advances by the development of Standards and Codes.

Meetings

Table 1 shows the Society and Professional Divisions meetings that were held during the fiscal year. In addition there were 649 meetings of the Local Sections and 547 Student Branch meetings. Ten successful Student Branch Conferences were held with an attendance of 2042 students and faculty members.

TABLE 1 ANALYSIS OF NATIONAL MEETINGS OF SOCIETY AND DIVISIONS

Meeting	Papers and addresses	Authors	Total registered
Society:			
Annual, Philadelphia, Pa., December, 1939	103	125	2234
Spring, Worcester, Mass., May, 1940	34	39	520
Semi-Annual, Milwaukee, Wis., June, 1940	32	40	638
Fall, Spokane, Wash., September, 1940	28	36	277
Professional Divisions:			
Fuels (with A.I.M.E.), Columbus, Ohio, October, 1939	13	14	325
Wood Industries, Boston, Mass., October, 1939	9	9	105
Petroleum Fluid Metering Conference (with University of Okla.), Norman, Okla., April, 1940	14	15	350
Petroleum, Norman, Okla., April, 1940	19	21	200
Oil and Gas Power, Asbury Park, N. J., June, 1940	14	19	180
Applied Mechanics, Ann Arbor, Mich., June, 1940	14	17	105
Shell Manufacture (Metals Engineering and Machine Shop Practice), Pittsburgh, Pa., September, 1940	6	6	280
Total	286	341	5214
Corresponding totals for 1938-1939	209	252	4835

For the third year in succession the Society held its four national meetings at widely separated points, giving maximum opportunity for the individual members to participate in these highly significant gatherings. The Annual Meeting in Philadelphia broke a precedent of long standing. Not only was it held outside of New York City but all of the events were under one roof in a hotel. The meeting was a splendid success. With the more flexible facilities available in a hotel it was possible for the Society to stage a much larger number of sessions with more papers which is reflected in Table 1 in the increase from 209 last year to 286 for the year 1939-1940. The greater convenience of a hotel meeting coupled to the possibility that more sessions might be held, led to the decision to hold the 1940 Annual Meeting in the Hotel Astor in New York City.

All of the Professional Divisions and four special research committees cooperated in preparing a program for the 1939 Annual Meeting.

The Worcester meeting with its fine program and inspection trips served a useful purpose in bringing the leaders of the Society into close touch with the leaders of industry in New England, many of whom are active in Society affairs. The Milwaukee meeting took the Society to a great center of mechanical industry in the Middle West. The Spokane meeting gave members an opportunity to get acquainted with the mining and forest-products industries of the Northwest as well as to view the solution of the interesting mechanical problems in the construction of the Grand Coulee Dam.

Significant addresses of the meetings of the Society were:

"Postgraduate Training for Young Mechanical Engineers," by Alexander G. Christie, President of the Society (presidential address).

"New England Industries 1940," by John F. Tinsley, president, Associated Industries of Massachusetts and president and general manager of Crompton & Knowles Loom Works.

"Progress Report of an Amateur Economist," by Ralph E. Flanders, Past-President, The American Society of Mechanical Engineers, president, Jones & Lamson Machine Co., Springfield, Vt.

"Engineering Romance in Milwaukee," by George G. Post, vice-president, Wisconsin Electric Power Co., Milwaukee, Wis.

"The Grand Coulee Dam and the Columbia Basin Reclamation Project," by Frank A. Banks, supervising engineer and S. E. Hutton, Mem. A.S.M.E., assistant director, of information, U. S. Bureau of Reclamation, Coulee Dam, Wash.

"Pioneers," by E. O. Eastwood, Mem. A.S.M.E., head, department of mechanical engineering, University of Washington, Seattle, Wash.

The sixtieth anniversary of the Society was celebrated by a nation-wide scheme of Local Sections Meetings during April; in many cases the celebration was combined with the anniversary of the founding of a particular Local Section. Officers of the Society and older members participated in the programs and related something of the traditions and purposes of the Society. In addition there were technical papers of high excellence.

Publications

During the last year a major portion of the effort of the Committee on Publications has been devoted to a study of unit costs affecting Transactions. This study to which a subcommittee has devoted a large amount of time and effort is enabling the committee to appraise with greater accuracy the effect on the publications budget of the suggestions for changes in the method of publishing and distributing Transactions which are constantly coming before us.

Since its organization, the Applied Mechanics Division has been ambitious to have an adequate publication outlet for the work in this field. Early this year the division made certain proposals to the Committee on Publications relating to a change in policy of the publication of the *Journal of Applied Mechanics*. After a careful study of this question and the costs involved, the committee recommended a plan to the Council by which the *Journal of Applied Mechanics* was to be made an independent publication available to A.S.M.E. members at $1 a year and requiring a reduced appropriation from Transactions funds. Much dissatisfaction with the proposed charge of $1 for the *Journal* was expressed in the returns from the canvass of the members of the Applied Mechanics Division. It was evident that questions of Society policy beyond the scope of the responsibilities of the Committee on Publications were involved. The matter was, therefore, referred to the Executive Committee and has now been placed before the Board on Technology for further study. The work of the Applied Mechanics Division is basic. Advances in the field become the foundation for progress in many other technical fields embraced within the membership of this Society. The broad problem is how to assure the continued health of our Applied Mechanics Division and how to give adequate distribution of the results of its work to our membership. The two parts of the problem are so interlocked that no solution of one which ignores the other can be satisfactory.

For the last eight or nine years the reports of this committee have on many occasions called attention to the lack of funds so that Transactions could record completely the work of permanent value coming out of the Society's meetings. So far as immediate demands are concerned, expedients have been adopted which have satisfied the most urgent complaints. By means of these expedients, however, the record of the work of the Society has been scattered through various media, some outside of the Society itself, not all of which have the quality of permanence. The necessity for such expedients continues. Such expedients could be justified in an emergency, but the Society must soon face the question: When does an emergency cease to be an emergency and assume the permanence of a norm? The technical program of the Society is growing. The number of sessions at general meetings and hence the number of papers are increasing the fund of material available for Transactions. To continue in this direction without a proportionate increase in the Transactions budget implies either a lowering of the general standard of the technical work of the Society or a failure by the Society to meet its obligation to the future. This obligation requires the provision of a place in Transactions for all papers which, in the judgment of the sponsoring bodies, possess permanent value.

During the year 209 papers were published, 93 in Transactions and 116 in MECHANICAL ENGINEERING.

Professional Divisions

The significant trend in the work of the Professional Divisions was the succession of actions taken to bring closer together the various groups of specialists in mechanical engineering, both within and without the Society. The results were shown in (1) an increased number of meeting sessions sponsored jointly by two or more divisions, (2) a definite arrangement for cooperation between the divisions and the Standing Committee on Research, and (3) an understanding with the Society of Naval Architects and Marine Engineers about the coordination of the meetings of the two Societies devoted to marine subjects.

Definite steps have been taken by the Council to provide increased support to several of the Divisions which have needed it badly.

The name of the Iron and Steel Division was changed to Metals Engineering which reflects the broadened scope to include nonferrous metals. An Ammunition Group has been organized to discuss the problems of the design and manufacture of the metal components of artillery ammunition.

Research

The detailed reports of the joint and special research committees are most impressive. They disclose the wide interests and activities of the Society and the scores of able men who are devoting time, effort, and skill to furthering the engineering profession. Good progress has been made toward the completion of the projects assigned. Solicitation for funds was made by four committees while The Engineering Foundation made generous grants to five of the Society's research projects.

During the year the Research Committee made a study of the policies and practices of the Society with respect to research. In doing this it accepted the principle that well-considered change is the essence of progress. In its report, "The Functions and Procedures of the Standing Committee on Research," which was approved in principle by the Council, the Committee recommends that the Society should extend its research activities in an effective and efficient manner.

Standardization

The following standards were completed during the year:

Twist Drills, B5

Backlash for General Purpose Spur Gearing, B6

Keyways for Holes in Gears, B6

250-Lb Cast-Iron Flanges and Flanged Fittings (revision), B26

Surface Roughness, B46

Abbreviations for Scientific and Engineering Terms (revision), Z10
Steel Butt-Welding Fittings, B16
Corrections to American Standard for Steel Pipe Flanges and Flanged Fittings, B16
Wrench-Head Bolts and Nuts and Wrench Openings (revision), B18
Soldered Joint Fittings, A40
125 and 250-Lb Cast-Iron Screwed Fittings (revision), B16.

Power Test Codes

Within the twelve months of the last fiscal year three power test codes and a supplementary publication on Definitions and Values reached the final stages of the Society's approval procedure. The test codes are those on Gaseous Fuels (new), Steam Turbines (revision), and Dust-Separating Apparatus (new). In addition Technical Committee No. 19 on Instruments and Apparatus completed eight sections of its comprehensive supplementary publications within the year. Good progress is reported also in the revision of seven other test codes and supplementary papers.

Safety

The development of a series of tables for the use of industrial plants in determining their accident-prevention rating has occupied the attention of the A.S.M.E. Safety Committee during the last year. The new Safety Code for Cranes, Derricks, and Hoists will presently be ready for submission to the A.S.M.E. Council. Work on the revision of the Elevator Safety Code has been initiated.

Boiler Code

In addition to its regular work of interpretations and revisions to the Boiler Code, the Boiler Code Committee has issued a revised table of gages of tubes for water-tube boilers. The table of working stresses for ferrous materials has been revised. Rulings have been issued for the use of stainless steel and clad materials in unfired pressure vessels. The rules for the qualification of welding procedure and welding operators have been revised to conform with the latest rules of the American Welding Society. As a result of a thorough investigation, Par. CA-5 of the Suggested Rules for the Care of Power Boilers has been revised to the effect that operating evidence shows no embrittlement in boilers designed to operate at or above 400 lb. A 1940 edition of the A.S.M.E. Boiler Construction Code is under preparation.

Library

During the year the lending rules of the Library were liberalized so that volumes from the general collection (with the exception of rare books) are now available to the members who are not residing within visiting distance of the Library. The lending charges are to cover costs only and are estimated on the basis of average mailing insurance costs. If the new rules indicate that a need is being met a further liberalization will be considered.

Awards

During the year the following honors were awarded by the Society:
Honorary Membership to Charles T. Main, Dexter S. Kimball, and Edwin J. Prindle
Holley Medal to Carl Edward Johansson
A.S.M.E. Medal to James E. Gleason
Worcester Reed Warner Medal to Rupen Eksergian
Melville Medal to Lester M. Goldsmith
Pi Tau Sigma Medal to John I. Yellott, Jr.
Charles T. Main Award to James R. Bright
Hess Student Award (Undergraduate) to David T. James.

II—THE ENGINEERING PROFESSION

The Society cooperates with other engineering societies and joint bodies organized for special purposes to aid in the development of the engineering profession as a whole. There are several special Society committees that are concerned with related functions. This section of the report will review briefly the work of these joint bodies and of the related Society committees.

American Engineering Council

The American Engineering Council is a joint organization of the engineering profession "to further public welfare wherever technical and engineering knowledge and experience are involved and to consider and act upon matters of concern to the engineering and allied technical professions." At the present time it has 55 member bodies—8 national, 17 sectional, and 30 local.

During the year American Engineering Council undertook three new special assignments: A Code of Ethics for the engineering profession, a program for developing better inter-American engineering relations, and the appointment of an advisory committee for the publication of the forthcoming edition of "Who's Who in Engineering."

Engineers' Council for Professional Development

The Engineers' Council for Professional Development, a conference of engineering bodies organized "to enhance the professional status of the engineer through the cooperative support of those national organizations directly representing the professional, technical, educational, and legislative phases of an engineer's life" has entered its eighth year.

During the last year, the Committee on Engineering Schools has continued its program of surveys and resurveys of engineering curricula. A group of technical institutes has petitioned the E.C.P.D. to institute, through this committee, a study of nondegree programs, both day and evening, in this country, and to devise and propose a plan of recognition or accrediting "as may seem wise and just."

Under the direction of the Committee on Schools, the E.C.P.D. distributed the report prepared by D. C. Jackson, entitled "Present Status and Trends of Engineering Education in the United States."

The Committee on Professional Training, jointly with eight institutions, sponsored the issuance of an announcement on Courses for Engineers in the City of New York and vicinity in which is listed a wide variety of fields of instruction of interest to engineers, as well as a partial list of educational institutions that offer instruction in some or all of these fields.

The Committee on Professional Recognition continued the discussion of the standards for the various grades of membership in the Founder Societies in the hope of finding common grounds.

The Committee on Selection and Guidance continued its program of organizing committees of engineers in local sections and in state and city societies of engineers. The most outstanding successes have been in the New York metropolitan area, in Detroit, Denver, and Omaha.

The Engineering Institute of Canada has been admitted to participation in the Engineers' Council for Professional Development.

Registration

Forty-two states and two territories now require registration or a license to permit an engineer to practice in the state.

The proper functioning of the various registration laws requires the understanding and support of the individual engineers. Working through the local sections, the Committee on Registration is striving to improve this understanding of A.S.M.E. members.

Helping the Young Engineer

In addition to the Engineers' Council for Professional Development which is mentioned here, the Committees on Engineers' Civic Responsibilities, the Economic Status of the Engineer, and Local Sections are devoting a substantial amount of time to the problem of helping the young engineer.

During the year, the name of the Committee on Manual of Citizenship was changed to that of the Committee on Engineers' Civic Responsibilities. Its membership was enlarged and, in addition, the chairmen of the Committees on Local Sections and on Relations With colleges were added in order to integrate the efforts of the committee with those of the local sections and student branches. The immediate objective of the Committee on Engineers' Civic Responsibilities is to interest the younger members of the Sociey in their combined civic and professional responsibilities.

The question of unionization in the engineering profession has puzzled junior engineers. The Committee on the Economic Status of the Engineer initiated a discussion of this question in a paper by James H. Herron in the November, 1939, issue of MECHANICAL ENGINEERING. In the seven months immediately following more than 24 pages of comment by members appeared in our monthly journal indicating no little interest in the question. The committee is now considering an appropriate conclusion on the subject.

The Society participated in the National Conference on Engineering Positions which was organized during the year, the Committee on Economic Status cooperating and designating representatives of the Society in this effort. The usefulness of this conference will be to provide a clearer idea of the responsibilities of engineering positions, particularly in the junior grades.

The Committee on Local Sections is particularly anxious that Junior members be brought into greater usefulness to themselves and the Society and has appointed a committee of five Juniors to prepare a report suggesting better methods of dealing with the interests and activities of the Junior members.

Junior members were invited to attend each meeting of the Council of the Society and report their recommendations, with very interesting results.

III—ADMINISTRATIVE MATTERS

Membership

Table 2 shows that the total membership increased during the year from 14,728 to 14,846. The total number of Junior members increased by 267 while the number of grade of Member decreased by 144. The Committee on Local Sections has been given the responsibility of developing a program which will attract to membership men of recognized standing in engineering.

In addition to recommending the transfer of 2886 from Student member to Junior member, the Committee on Admissions recommended the promotion of 54 and the election of 467 new members in the various grades. The uncertainties in the interpretation of the Fellow grade were given consideration by the Local Sections Conferences, the Group Delegates' Conference, and the Council, both at the December meeting and at the June meeting which resulted in a clarifying statement by the Committee on Admissions which was published in the September, 1940, issue of MECHANICAL ENGINEERING as the basis for further discussion and possible action at the 1940 Annual Meeting.

The Board of Review considered 641 cases leading to reinstatements, resignations, or other related recommendations.

Constitutional Changes

During the year the Constitution was amended by the members to clarify the provisions for election of directors and for determining the meeting places of the Society. The By-Laws were amended by the Council to clarify the auditing and accounting procedures and to increase the number of groups of local sections from seven to eight.

Employment Service

During the year the Society, jointly with the three other Founder Societies, authorized the incorporation of the Joint Employment Service as a non-profit-making institution in the State of New York under the name of Engineering Societies Personnel Service, Inc. A branch of this new corporation was installed in Detroit during the summer with the cooperation of the Engineering Society of Detroit.

Sections Conferences

Representatives of the 70 local sections of the Society met in the fall of 1939 in seven geographical groups and discussed various questions of Society operation and policy. Representatives of these group conferences met in Philadelphia at the time of the 1939 Annual Meeting and formulated recommendations presenting the results of the various conferences. The Executive Committee considered the recommendations at meetings thereafter and at the Milwaukee meeting of the Council in June, 1940, there was a thorough discussion of the recommendations and the necessary action thereon.

The relationship between the sections and the members of the Council has been given a great deal of consideration from time to time. During this year as a means of improving this relationship and of improving the functioning of the individual Sections, the Council authorized a change in the By-Laws whereby the number of groups or sections was increased from seven to eight, the new area comprising the North and South

TABLE 2 CHANGES IN MEMBERSHIP

(September 30, 1939, to September 30, 1940)

	Membership		Increases			Decreases				Changes		
	Sept. 30, 1940	Sept. 30, 1939	Transferred to	Elected	Reinstated	Transferred from	Resigned	Dropped	Died	Increases	Decreases	Net changes
Honorary Members	19	16	3							3		+ 3
Fellows	114	112	7			2	1		2	7	5	+ 2
Members	8099	8243	37	214	130	7	131	262	125	381	525	—144
Associates	215	225			3		7	2	4	3	13	— 10
Junior (20)	1000	921	181	47	57	24	54	123	5	285	206	+ 79
Junior (15)	743	710	102	44	15	13	30	84	1	161	128	+ 33
Junior (10)	4656	4501		1220	28	284	108	695	6	1248	1093	+155
Total membership	14846	14728	330	1525	233	330	331	1166	143	2088	1970	+118

Texas, Mid-Continent, Kansas City, Colorado, and New Orleans Sections. As an important prevailing technical interest in this area is petroleum, it is expected that this new group will facilitate the work of the Petroleum Division of the Society.

The Parker Case

The first action brought by John Clinton Parker called the "visitation proceeding" resulted in a judgment against Mr. Parker of $1500 in costs. During the summer the action on this judgment was brought to a close and as the fiscal year ended, settlement was being negotiated by Mr. Parker's counsel.

No action has been taken as yet in the collection of the judgment of some $2900 against Mr. Parker and his associates which resulted from the second case.

Office Operation

The Council recognized the importance of an efficient Society office and appointed a Special Committee on Society Office Operation which reported that the work of the office was up to date and well managed and that the general arrangement and orderliness are excellent.

The staff has been undermanned in respect to high-grade men to carry on the Society work and guarantee continuity. An additional capable technical man was provided for in the 1940-1941 Budget.

The Mid-Continent office at Tulsa was closed on September 30, 1940. Dean W. H. Carson of the University of Oklahoma was retained to carry on the Petroleum Division activities in the Mid-Continent area.

The Secretary served ten weeks in the office of the Chief of Ordnance during August, September, and October, 1940.

Council Meetings and Activities

The Council held two meetings, at the Annual Meeting in Philadelphia in December, 1939, and at the Semi-Annual Meeting in Milwaukee in June, 1940. In addition the eastern members met with the Executive Committee at Worcester in May, 1940, and the western members met at Spokane in September, 1940.

The Executive Committee held 9 meetings.

Finances

The complete report of the Finance Committee follows this report of the Council.

Committee Reports

The full reports of the Committees of the Society and of its representatives on joint agencies are embodied in a pamphlet of 37 pages available for distribution upon request.

Deaths

Among the members who died during the year were Fred J. Miller, Past-President, Samuel M. Vauclain, Honorary Member, John A. Hunter, F. W. Dean, and L. P. Breckenridge, former members of the Council.

STUDY IN STEAM

(Photograph taken by George Hyde and shown at the Fifth Annual Photographic Exhibit held during the A.S.M.E. Annual Meeting, Dec. 2–6, 1940, New York, N. Y.)

A.S.M.E. FINANCE COMMITTEE REPORT, 1939-1940

Financial Review

THE Standing Committee on Finance shall, under the direction of the Council, have supervision of the financial affairs of the Society, including the books of account. In accordance, the Committee submits the following summary statement or review of the financial operations of the Society for the year ending September 30, 1940. This is followed by the Balance Sheet (A), Comparative Summary of Income and Expenses (B), Statement of Surplus (C), and the Public Accountants' report on their examination of these statements.

Operating details are provided in statement (D) Cost of Activities, and (E) a popular presentation of "How the A.S.M.E. Spent Its Income in 1939–1940."

Attention is called to the fact that this current report follows the general lines developed by the committee and used last year as it is believed that the information given and the form of its presentation will afford to all members a clear picture of the Society's activities and the financial situation at the end of the year resulting therefrom.

Operating Summary

Balance Sheet—Exhibit A

The Balance Sheet of September 30, 1940, shows, on that date, that the Society owed:

(1) One member who holds an unredeemed certificate of indebtedness with interest	$ 510.00	
(2) Current bills	165.18	
(3) Obligations for printing and distributing the 1940 Mechanical Catalog, bills for which have not been submitted	10,984.15	
(4) Other obligations for which bills have not been submitted	8,530.99	
(5) Special research and other committees which have collected funds for special purposes to be expended as needed	33,387.47	
(6) For future services to Members who have prepaid their dues	52,522.06	
(7) Advertisers and subscribers to publications who have prepaid	4,026.40	
		$110,126.25

To meet these debts the Society had:

(1) Cash in the bank	$ 83,953.33	
(2) Accounts and notes receivable	40,902.04	
(3) Inventories of publications and supplies conservatively valued at	24,772.69	
(4) Securities at a quoted market value of	137,905.91	
(5) Prepaid expenses of	291.61	
		$287,825.58

The difference between the value held by the Society of $287,825.58 and debts of $110,126.25 is the net worth of the Society on September 30, 1940 ..... $177,699.33

The Society had other liabilities:

(1) Trust funds amounting to		$111,478.39
against which the Society had the following assets:		
(a) Cash	$ 17,730.68	
(b) Notes receivable	4,329.84	
(c) Securities of market value	89,417.87	
	$111,478.39	
(2) Property fund of		$522,224.00
with the following assets to support it:		
(a) Quarter interest in building	$498,448.48	
(b) Office furniture and fixtures (depreciated value)	23,773.52	
(c) Library books	1.00	
(d) Engineering Index, Inc.—title and good will	1.00	
	$522,224.00	
(3) Employees' Retirement Fund of		$ 14,396.16
covered by:		
Cash	$ 4,446.16	
Securities of market value	9,950.00	
	$ 14,396.16	

The total of the Society's Investment and Trust Fund Portfolios is $237,273.78, of which approximately 60 per cent is Lawyers Mortgage Company certificates, the cost of which as shown in last year's report was $257,254.12 and with an appraised value of $138,424.72. Redemptions and sales during the year have reduced the cost value to $251,631.64. The present appraised market value is $141,414.21. A write-up adjustment of $7,618.40 was made. The cash income received during the year from these certificates was $12,293.41. Average yields on these real-estate mortgage certificates were:

	Trust Fund Assets	Society Investments	Aggregate
Based on Cost	5.18	5.04	5.09
Based on Market	9.63	9.30	9.40

The Security Portfolio was enlarged during the year by the purchase of high-grade bonds and preferred stocks totaling $61,087.22.

Income and Expense—Exhibit B

The total income received during the year 1939–1940 was $15,453.19 more than that received during the year 1938–1939. The membership dues received were higher by $3,076.01 and revenues from Mechanical Engineering advertising and Mechanical Catalog advertising were $10,633.60 more than received during 1938–1939. Revenue from publication sales was lower by $2,259.47 but there was a decrease in cost of sales.

Surplus—Exhibit C

Operating results of the year involve crediting Surplus with $16,765.31, or $1,501.55 less than the previous year, but there are certain nonoperating items which modify the final status of the Surplus account. Chiefly among these nonoperating items were a credit to Surplus of $5,601.65 consisting of a write-up of securities (Society Investments) which was based on a conservative appraisal of the Society's holdings in Mortgage Certificates, and an overestimate of anticipated unpaid bills for last year's operations. There were no nonoperating charges to be made against Surplus. Surplus, after all additions as shown in Exhibit C, now stands at $177,699.33 or $32,664.91 more than last year.

J. J. Swan, *Chairman*
J. L. Kopp, *Vice-Chairman*
K. W. Jappe
G. L. Knight
W. Slichter
K. M. Irwin } *Council*
C. L. Bausch } *Representatives*

EXHIBIT A

BALANCE SHEET—SEPTEMBER 30, 1940

ASSETS

GENERAL FUND:			
Cash in banks and on hand (including $510 reserved for retirement of certificate of indebtedness)			$ 83,953.33
Accounts receivable:			
Dues—current year	$17,923.69		
Dues—prior years	615.50		
	$18,539.19		
Less—Reserve	18,539.19	—	
Publications and advertising	$43,378.36		
Less—Reserve	3,560.16	$ 39,818.20	
Miscellaneous		903.84	40,722.04
Notes receivable			180.00
Inventories, at cost or less:			
Publications completed		$ 11,853.15	
Publications in process		13,826.27	
		$ 25,679.42	
Less—Reserve		3,735.33	
		$ 21,944.09	
Supplies		2,828.60	24,772.69
Securities (at the lower of cost or approximate quoted market values):			
Real-estate mortgage bonds and certificates		$ 95,073.78	
Railroad and industrial stocks and bonds		42,832.13	137,905.91
Prepaid insurance			291.61
			$287,825.58
EMPLOYEES' RETIREMENT FUND:			
Cash in banks		$ 4,446.16	
Real-estate mortgage certificate (at approximate quoted market value)		9,950.00	
			14,396.16
TRUST FUNDS:			
Cash in banks		$ 17,730.68	
Notes receivable (Major Toltz Fund)		4,329.84	
Securities (at the lower of cost or approximate quoted market values):			
Stocks and bonds		51,497.44	
Real-estate mortgage certificates		37,920.43	
			111,478.39
PROPERTY FUND:			
One-fourth interest in real estate and other assets of United Engineering Trustees, Inc., exclusive of Trust Funds		$498.448.48	
Office furniture and fixtures (depreciated value)		23,773.52	
Library books		1.00	
Engineering Index, Inc.—Title and good will		1.00	
			522,224.00
			$935,924.13

LIABILITIES

GENERAL FUND:			
Certificate of indebtedness and accrued interest thereon			$ 510.00
Accounts payable			165.18
Accrued liabilities:			
Estimated liability relating to Mechanical Catalog for 1940–1941		$10,984.15	
Others (estimated)		8,530.99	
			19,515.14
Unexpended balances of Custodian Funds			33,387.47
Deferred credits:			
Dues and initiation fees paid in advance		$52,522.06	
Prepaid subscriptions		4,000.00	
Prepaid advertising		26.40	
			56,548.46
Surplus (Exhibit C)			177,699.33
			$287,825.58
EMPLOYEES' RETIREMENT FUND			14,396.16
TRUST FUNDS (including unexpended income)			111,478.39
PROPERTY FUND			522,224.00
NOTE: Initiation and promotion fees receivable are not included in the above statement as they are taken up by the Society only as and when collected.			
			$935,924.13

ACCOUNTANTS' CERTIFICATE

TO COUNCIL OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

We have examined the balance sheet of The American Society of Mechanical Engineers as at September 30, 1940, and the summary of income and expenses and statement of surplus for the fiscal year ending that date, have reviewed the system of internal control and the accounting procedures of the Society and, without making a detailed audit of the transactions, have examined or tested accounting records of the Society and other supporting evidence, by methods and to the extent we deemed appropriate.

In accordance with the practice followed by the Society in prior years, no effect has been given in the statements to accrued income on investments.

The membership dues are included in the income account of the current year on the basis of total cash received on account of that year and prior years, and provision has been made for all dues uncollected at September 30, 1940.

In our opinion, with the foregoing explanations, the accompanying balance sheet and related summary of income and expenses and statement of surplus present fairly the position of The American Society of Mechanical Engineers at September 30, 1940, and the results of its operations for the fiscal year, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

(Signed) PRICE, WATERHOUSE & CO.

New York, N. Y.
October 30, 1940

EXHIBIT B

COMPARATIVE SUMMARY OF INCOME AND EXPENSES

For the Two Years Ending September 30, 1940

	Year 1939–1940	Year 1938–1939
INCOME:		
Initiation and promotion fees (to surplus)	$ 9,155.64	$ 7,630.19
Membership dues*	$217,382.04	$214,306.03
Student dues	20,420.55	18,193.00
Interest and discount (net)	10,609.36	9,209.59
MECHANICAL ENGINEERING advertising	79,551.82	71,987.56
Mechanical Catalog advertising	41,551.10	38,481.76
Membership List advertising	668.00	.....
Publication sales	55,793.16	58,052.63
Miscellaneous sales	1,619.10	1,485.25
Contributions—*Journal of Applied Mechanics*	1,350.00	1,200.00
Engineering Index, Inc.	564.24	518.86
Registration fees	287.00	221.00
Sale of equipment	82.50	770.00
TOTAL INCOME	$429,878.87	$414,425.68
EXPENSES:		
Expenses under committee supervision	$ 82,164.46	$ 76,378.69
Publication expense	133,861.14	128,739.81
Office expense	197,087.96	191,040.32
TOTAL EXPENSES	$413,113.56	$396,158.82
Net income for the year	$ 16,765.31	$ 18,266.86

* Membership dues have been stated on the basis of total cash received during the year.

EXHIBIT C

STATEMENT OF SURPLUS

Year Ending September 30, 1940

BALANCE, SEPTEMBER 30, 1939	$145,034.42
ADD:	
Initiation and promotion fees collected	9,155.64*
Net income for year (Exhibit B)	16,765.31
Adjustment (net) of carrying value of securities owned to approximate quoted market value at September 30, 1940 (exclusive of adjustment of $2,595.55 in respect of Trust Fund investments credited to Trust Funds)	5,601.65**
Unexpended balance of estimated accrued liabilities for the year 1938–1939	1,142.31
BALANCE, SEPTEMBER 30, 1940	$177,699.33

* As it is the practice of the Society to take up initiation and promotion fees only as and when collected, the above statement does not include such fees receivable at September 30, 1940.

** After giving effect of this adjustment, the carrying value of these securities is still $88,849.62 below cost. Trust Fund securities are carried at $34,956.84 below cost.

EXHIBIT D

DETAILED COST OF A.S.M.E. ACTIVITIES, 1939–1940

(Approved by Finance Committee, October 18, 1940)

	Expense under committee supervision	Printing and distribution expense	Office expense	Total Cost 1939–1940	Total Cost 1938–1939
Council	$ 6,448.69			$ 6,448.69	$ 4,528.46
Library	9,207.20			9,207.20	9,118.00
American Engineering Council	8,300.00			8,300.00	8,300.00
Engineers' Council for Professional Development	850.00			850.00	850.00
Finance Committee Expense	108.00			108.00	220.00
Awards	893.33		408.54	1,301.87	943.83
Nominating Committee	485.96			485.96	476.62
Constitution and By-Laws					124.58
Local Sections	22,899.98		6,797.67	29,697.65	29,274.50
Meetings and Program	6,691.19		4,920.91	11,612.10	11,445.69
Professional Divisions	4,704.05		4,920.91	9,624.96	7,591.72
Admissions			7,669.02	7,669.02	7,428.81
Employment Service	2,643.24			2,643.24	2,643.72
Student Branches	9,994.02	5,514.69	4,292.81	19,801.52	18,684.96
Technical Committees	1,000.00		19,382.64	20,382.64	20,281.33
MECHANICAL ENGINEERING Text Pages		26,488.43	10,767.55	37,255.98	37,613.60
Transactions and *Journal of Applied Mechanics*	155.09	29,766.87	11,652.19	41,574.15	43,815.27
Membership List		7,022.69	3,402.84	10,425.53	.82
MECHANICAL ENGINEERING Advertising Pages		17,794.19	23,274.44	41,068.63	37,345.82
A.S.M.E. Mechanical Catalog		21,000.00	17,588.64	38,588.64	38,571.24
Publications for Sale		26,274.27	8,834.82	35,109.09	35,927.45
Retirement Fund	2,700.00			2,700.00	2,700.00
Parker Case	102.20			102.20	1,450.27
Professional Services	1,098.50			1,098.50	1,073.50
Membership Development	2,500.00			2,500.00	1,500.00
Organization Charts	33.01			33.01	300.00
Biographical Data—Membership	1,350.00			1,350.00	
Secretary's Office			17,125.82	17,125.82	17,208.57
Accounting			13,702.82	13,702.82	13,572.28
General Service			25,000.47	25,000.47	24,925.20
General Office Expense			17,345.87	17,345.87	18,242.58
TOTALS	$82,164.46	$133,861.14	$197,087.96	$413,113.56	$396,158.82

How the A.S.M.E. Spent Its Income in 1939-1940

EXHIBIT E

Dues Income: $217,382.04—$14.64 per Member.

The principal item of income is the dues paid by the members. Juniors pay $10, $15, or $20 depending upon their age; Members pay $20, Fellows, $25, except that those who have been on the rolls of the Society for 35 years or who have reached 70 and have been members 30 years are carried without dues. On September 30 the Society had 14,846 members on its rolls and during the year $217,382.04 was collected in dues. The per-member dues income is therefore $14.64.

Publications: Net Expense $61,288.87—$4.13 per Member.

The publications of the Society are MECHANICAL ENGINEERING, Transactions, including the *Journal of Applied Mechanics*, the Membership List, and the A.S.M.E. Mechanical Catalog and Directory. Income is obtained from advertising in MECHANICAL ENGINEERING and in the Catalog. Contributions have been received for the *Journal of Applied Mechanics*. An income and expense statement for the publications appears below.

PUBLICATIONS

	Direct expense	Income
MECHANICAL ENGINEERING	$ 78,324.61	$ 79,551.82[a]
Transactions (including *Journal of Applied Mechanics*) and (Membership List)	51,999.68	2,018.00
A.S.M.E. Mechanical Catalog	38,588.64	41,551.10
Publications sold	35,109.09	55,793.16
	$204,022.02	$178,914.08
Indirect expense	$ 36,180.93	
	$240,202.95	
Less income	178,914.08	
Net cost of publications	$ 61,288.87	
Total expense of publications per member	$ 16.18	
Publications income per member	12.05	
Net expense per member	$ 4.13	

[a] No allowance is included for what might be considered as A.S.M.E. Member subscriptions to MECHANICAL ENGINEERING or Transactions. The net expense of $4.13 may be regarded as the amount of these subscriptions.

Technical Committee Work: Net Expense $24,546.36—$1.65 per Member.

The Society has nearly two hundred technical committees engaged in the work on research, establishing power test codes, preparing the boiler code, and in preparing standards and safety codes. The work of these committees is supported by direct staff expense which in 1939–1940 was $20,382.64. Adding to it indirect general expense of $4,163.72 gives a total expense of $24,546.36; which on a per-member basis is $1.65. The principal output of the technical committees is publications which are sold to members and to others. This figure of expense should therefore be considered in relation to the publication expense of the Society.

General Society Activities: Net Expense $73,896.80—$4.98 per Member.

The general activities of the Society include the holding of meetings, the operation of Local Sections, Professional Divisions, Student Branches, the administration of the procedure for admitting members to the Society, and the bestowal of awards. The Society receives income from Students for their membership in the Society. The following tabulation shows the net expense for this activity.

GENERAL SOCIETY ACTIVITY EXPENSES

	Direct expense	Income
Society Meetings	$11,612.10	$ 287.00
Local Sections	29,697.65	
Professional Divisions	9,624.96	
Student Branches	19,801.52	20,420.55
Admissions	7,669.02	
Awards	1,301.87	
	$79,707.12	$20,707.55
Indirect expense	14,897.23	
	$94,604.35	
Less income	20,707.55	
Net cost of general Society activities	$73,896.80	
Total expense of general Society activities per member	$ 6.37	
Income per member	1.39	
Net expense per member	$ 4.98	

Joint Activities: Net Expense $30,168.26—$2.03 per Member.

The Society also participates in a number of joint activities such as the Library, American Engineering Council, Engineers' Council for Professional Development, and the joint Employment Service. In addition to the payments to these joint bodies for these purposes a certain amount of general expense is allocated to these activities. The following tabulation gives the total of this expense.

JOINT ACTIVITIES

	Direct expense
Engineers' Council for Professional Development	$ 850.00
Engineering Societies Library	9,207.20
American Engineering Council	8,300.00
Employment Service	2,643.24
	$21,000.44
Indirect expense	9,167.82
Total cost of joint activities	$30,168.26
Expense per member	$ 2.03

Administrative: Net Expense $10,716.44—$.72 per Member.

In carrying out the Society activities certain administrative services must be provided. These include the expense of the Council, the nominating committee, and the provision for auditing, legal, and other services. Certain general income is received. The following tabulation shows the amount of this expense and income.

General Society Administration

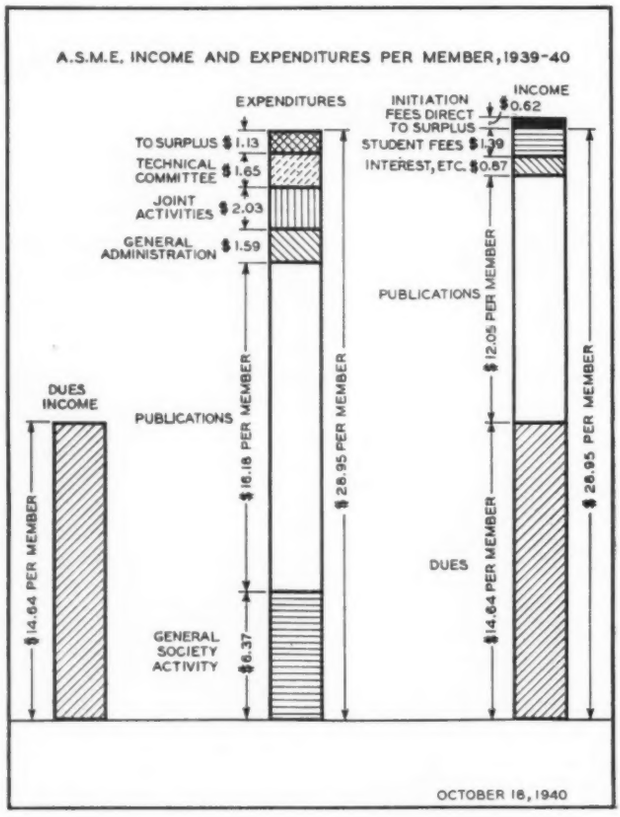
	Direct expense
Council	$ 6,448.69
Nominating Committee	485.96
Retirement Fund	2,700.00
Professional Services	1,098.50
Finance Committee	108.00
Parker Case	102.20
Membership Development	2,500.00
Biographical Data—Members	1,350.00
Organization Charts	33.01
	$14,826.36
Indirect expense	8,765.28
	$23,591.64
Income from interest and miscellaneous	12,875.20
Net cost of general Society administration	$10,716.44
Expense per member	$ 1.59
Income per member	.87
Net expense per member	$ .72

Recapitulation

	Expense	Income
Dues	$	$217,382.04
Publications	240,202.95	178,914.08
General Society Activity	94,604.35	20,707.55
Technical Committee Work	24,546.36	.....
General Society Administration	23,591.64	12,875.20
Joint Activity	30,168.26	.....
	$413,113.56	$429,878.87
Addition to surplus from operating income	16,765.31	
	$429,878.87	

Income and Expense per Member

	Expense per member	Income per member	Net expense per member
Dues	..	$14.64	...
Publications	$16.18	12.05	$4.13
Technical Committee	1.65	...	1.65
General Society Activity	6.37	1.39	4.98
Joint Activities	2.03	...	2.03
General Society Administration	1.59	.87	.72
	$27.82	$28.95	
Addition to surplus from operating income	1.13		
	$28.95		



NATIONAL DEFENSE—KEYNOTE *of* 1940 A.S.M.E. ANNUAL MEETING

2530 Register to Enjoy 103 Papers at 44 Technical Sessions

ENCOURAGED by the success of the 1939 Annual Meeting with the Hotel Bellevue-Stratford, Philadelphia, as headquarters, and forced to find additional meeting rooms for holding an unusually large number of simultaneous sessions, the Committee on Meetings and Program of The American Society of Mechanical Engineers, with the approval of the Council, took the 1940 A.S.M.E. Annual Meeting to the Hotel Astor, in Times Square, New York. There, during the week of December 1, one hundred and three technical papers were read at 44 sessions; and five public luncheons, the Annual Dinner, and an uncounted number of committee meetings, special luncheons, and dinners of Society groups were held from Sunday morning until Thursday night. But even the resources of a great hotel were taxed at times so that some committee meetings, luncheons, and dinners were held elsewhere. A total registration of 2530 was recorded, although, as usual, some persons went directly to meeting rooms without registering.

Many older A.S.M.E. members frankly stated that they missed the traditional atmosphere of the Engineering Societies Building which has been the customary meeting place for the Society's normal convention since 1907. The convivial hubbub of the lobby in the Thirty-Ninth Street headquarters which has always been such an enjoyable feature of these annual gatherings could not be properly duplicated in a hotel atmosphere. However, the meeting rooms in which the technical sessions were held were adequate in number and in seating capacity, opportunity was afforded for luncheons and dinners to be attended without leaving the meeting building, and many out-of-town members who stopped at the Astor found their time saved and their nerves not put to the test of dodging street traffic several times a day.

NATIONAL DEFENSE AND COOPERATION KEYNOTES

Throughout the 1940 Annual Meeting ran the thread of national-defense preparation and the problems and effects of the war in Europe. In his several informal addresses, President Warren H. McBryde alluded to it, as did President-Elect William A. Hanley. The Council, the Local Sections Group Delegates Conference, the speakers at luncheons, and Mr. Batt in his stirring Annual Dinner address dwelt on the subject. Several technical sessions were built up around engineering aspects of war and national defense, and private conversations were full of plans, experiences, and prognostications. With a world in chaos as a result of war, and with this country embarked on the most extensive national-defense program in all history, this accent on military affairs was to be expected.

On the other hand, as was equally to be expected, a majority of technical sessions were concerned with subjects that touched only remotely, or not at all, the major theme of preparedness. Advances in technology were discussed with the professional detachment of peacetime conditions, and a study of the program will show that what the research laboratories and the mechanical-engineering industries have been doing during recent years is rich in values that benefit the progress of the human race.

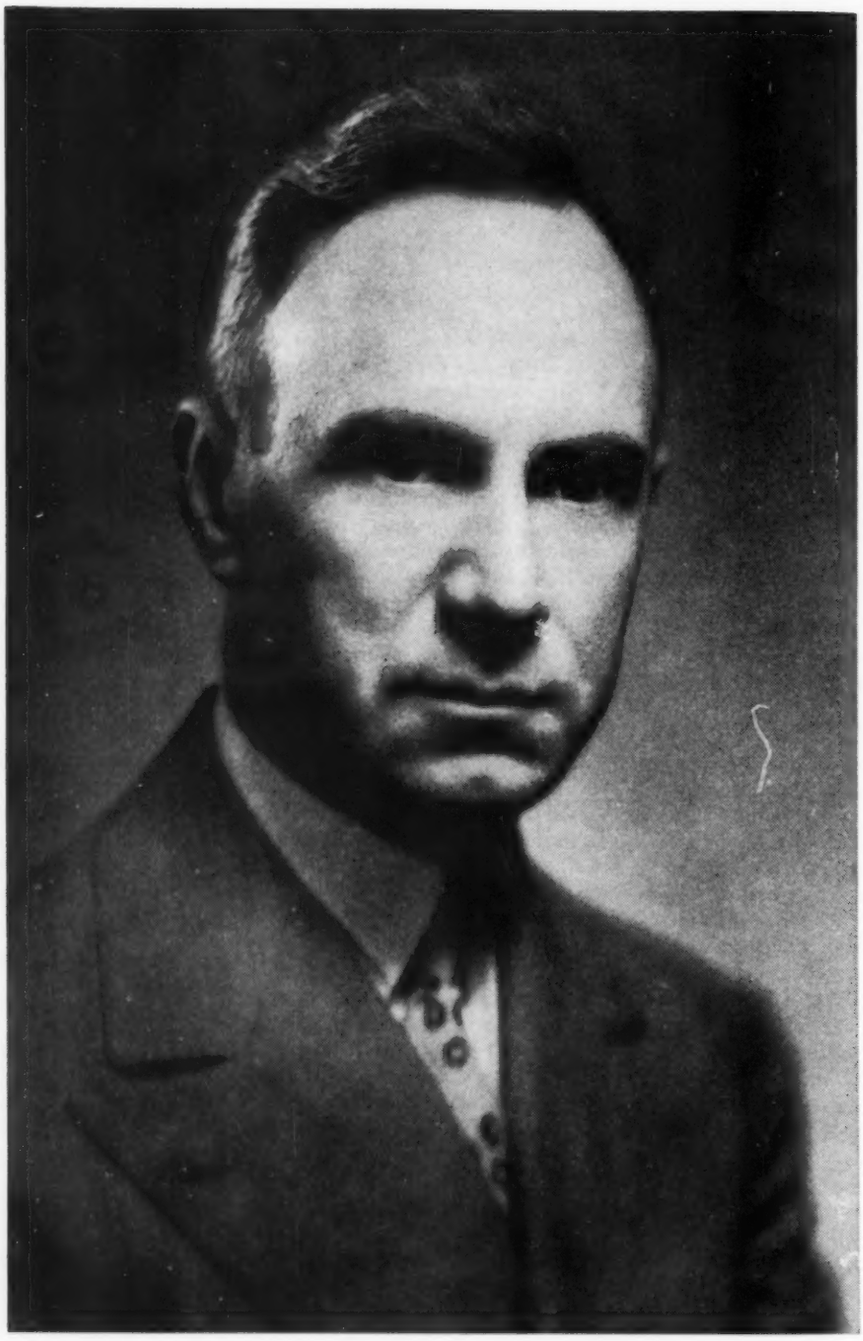
A trend in A.S.M.E. development that has been growing steadily and was even more pronounced than usual this year is the cooperation between technical and specialized groups in the Society and between the A.S.M.E. and other engineering societies. The number of joint sessions at the 1940 Annual Meeting was one evidence of this trend. Particularly significant was the considerable number of sessions sponsored jointly by the Applied Mechanics Division and other groups. As the interests of the Applied Mechanics Division cut across those of practically every other group, the cooperation of this division with others in analytical attacks on special problems results in an enrichment of engineering knowledge greatly to be desired. It is significant too that cooperation between the professional divisions and the Committee on Research resulted in the establishment in the divisions of research secretaries whose duty it will be to head up the research activities of the divisions. A session under the joint auspices of the American Society of Naval Architects and Marine Engineers demonstrated the feasibility of discussion of common problems in a forum in which experts from both fields can contribute. The Committee on Professional Divisions, which has given much study during the last year to cooperation with other engineering societies, thus successfully demonstrated the practicability of its program of encouraging joint sessions.

INFORMAL DISCUSSION OF SOCIETY PROBLEMS AT ENGINEERS' CLUB

For several years Sunday evening preceding the A.S.M.E. Annual Meeting has afforded an opportunity for members of the Council to meet with delegates from the local-sections groups and members of standing committees at a buffet supper, following which Society problems can be discussed frankly and informally. This year's supper was held at the Engineers' Club, where the evening was spent in this type of discussion. An air of informality was established by the brief words of welcome extended by Mr. McBryde and the rapid-fire introduction of every person present by Secretary Davies.

Mr. McBryde summarized the Council report, and emphasized particularly the impending dissolution of the American Engineering Council and the problem this posed in the affairs of the Council. He spoke also of registration of engineers and the encroachment of political bodies in the engineering profession. He said that with the consent of the A.S.M.E. Council the Secretary had spent considerable time in Washington on special duty and expressed his opinion that the Society was fortunate in having as its secretary a reserve officer in the Ordnance Department whose work, both for the Department and the Society, was of greater value because of this dual relationship.

Mr. Davies supplemented Mr. McBryde's summary of the Council report by calling attention to other features, particularly steps that had been taken in coordinating the work of the Society with that of other groups and in setting up a mechanism for closer cooperation between the Committee on Research and the professional divisions. He urged all members to fill out and send in the A.S.M.E. Professional and Biographical Data sheet, and not to confuse it with the National Roster of Scientific and Specialized Personnel being conducted from Washing-



William A. Hanley

President of
The American Society
of
Mechanical Engineers
for 1941

ton. He called attention to the liberalized lending rules of the Engineering Societies Library and to the list of duplicate volumes which the library is seeking to make available to other libraries. A decrease in membership in the senior grade was noted, he said, and he raised the question as to why some junior members did not apply for transfer to the higher grade.

Following Mr. Davies' remarks, general discussion was focused on several important problems. L. W. Wallace, first executive secretary of the American Engineering Council, made a strong plea for mature and sober consideration of the problem presented in the dissolution of the Council and expressed his faith in the importance of the mission the A.E.C. had been organized to perform. He drew sharp and dramatic distinction between the point of view that the A.E.C. was an organization for the benefit of the engineering profession and the more idealistic one, present in the minds of the Council's founders, he said, that it was a means by which the engineering profession could be of public service. As a single example of the manner in which the Council had, in times past, met the challenge of public service, he referred to the report on civil aviation, which had been undertaken during a critical period in the development of the aeronautical industry and which had beneficially influenced the character of legislature enacted at that time.

The entire subject of the American Engineering Council was thoroughly discussed from many angles, and many suggestions were put forward relating to ways in which the challenge to

Warren H. McBryde

Retiring President of
The American Society
of
Mechanical Engineers

the engineering profession, accentuated by the breaking down of the support the Council had been receiving, could be met. It was felt that the actions taken by the three national founder societies, which represented the majority of engineers in the Council and had been its major source of financial support, in which they had given notification of withdrawal at the end of 1940, had "cleared the atmosphere" and provided an opportunity for a fresh study of a joint engineering organization to carry on the work formerly done by the Council.

Other subjects discussed were the one raised by Mr. Davies as to why more junior members were not applying for promotion to a higher grade and the difficulties encountered by some juniors in securing licenses to practice. It was felt that the effects of the depression were to be noted in both of these problems; professional careers of young men had been interrupted or retarded and the promotion fee was a stumbling block in some cases.

CALVIN W. RICE TABLET UNVEILED

On Monday noon, in the lobby of the Engineering Societies Building, a tablet to Calvin W. Rice, former secretary, 1906–1934, that had been hanging in the Society rooms for several years, was unveiled by Secretary Davies and formally dedicated. Henry A. Lardner, fellow A.S.M.E. and president, United Engineering Trustees, Inc., the agency which handles the affairs of the Engineering Societies Building, the Engineering Societies

Library, and the Engineering Foundation, presided. He explained that the rules of the Trustees made it necessary for five years to elapse between the death of a person and the placing of a memorial to him in the public rooms of the building. It was most appropriate, he said, that a tablet to Mr. Rice should hang in the lobby of the building which the former secretary had been so influential in securing as a home for the engineering societies and their combined libraries. He then introduced Charles F. Scott, member A.S.M.E., who had been a member with Rice of the building committee and who had gone with Rice to solicit the interest and aid of Andrew Carnegie, donor of the building. Mr. Scott said:

It is fitting that the tablet to Calvin Rice should be placed here, where "If you seek his monument, look about you." Across the lobby are the Carnegie letter of gift and acknowledgment of the funds the societies raised for the land. In both Rice played a leading part.

The building we see, but we sense something here we cannot see. Engineering Societies Building is more than a structure; the societies animate it with a professional spirit and vigorous life; it is an institution with hundreds of active groups—technical and general—national and local. And in all this Rice was at the forefront; even before the building project he was chairman of the first committee for establishing local sections and student branches.

I first met Rice in the board meetings of the electrical engineers. As chairman of its building committee he reported monthly a fund of a few thousand dollars and a few doubtful prospects. But while the outlook seemed pitifully hopeless, what impressed me was the chairman; he continued persistently hopeful—hopeful that the electrical as well as the civil and mechanical engineers would have a home of its own and could receive the Latimer Clark Library.

In the fall of 1902 as incoming "electrical" president, I attended two eventful dinners. A magnificent affair at the Waldorf was sponsored by the four engineering societies. It did honor to John Fritz and inaugurated the John Fritz Medal. The second was at Rice's apartment.

His building committee considered plans and funds. The $200,000 sketches were alluring; those for $50,000 acceptable. As to funds, there seemed nothing to say. Presently I referred to the splendid joint engineers' dinner and proposed a single building for all the societies. It seemed too impossible.

Later Rice and Martin succeeded in securing Mr. Carnegie as guest at the electrical "Library" dinner. I repeated my proposal of cooperation among the engineering societies and a common building for all. It struck a responsive chord in the Iron Master.

The following afternoon Mr. Rice and I were in Mr. Carnegie's Fifth Avenue home. He wanted to talk matters over, "We three Pittsburghers," as he remarked. There were questions as to membership, income, resources, and the like. "Why, then you could support a building if you had one," indicated progress. Presently we reached the goal. When Rice gave assurance (while I held my breath) that the societies could pay for the land, "Oh, then I will give the building." And the air castle of that momentous half hour is here now; the home not of one society but of many; not for the gift library alone, but for our Engineering Societies Library. Thus the visions of the persistent Rice came to rich fruition.

Rice became secretary of the mechanical engineers in 1906; just before the building was dedicated. He came with a wide experience in industry, in engineering, and with men; it ranged from Lynn to Anaconda, including Schenectady and Pittsburgh and New York. He saw our modern industrial life from many angles. He had human understanding. He saw what engineering societies were doing and he visioned what they might do for their own members and for the nation, and also in world-wide cooperation. Anticipating the motto now on the Society's Fifty-Year Medal, "What Is Not Yet, May Be," he acted.

An old-time member likens the Society to a narrow-gage, single-track road—a *technical* society—until Rice came. He expanded it into a standard-gage modernized system, covering a wide area. He pioneered lines into fields of industrial relations, of economics, of social welfare. He installed interconnections with other branches of the profession. He visited England and Europe and South America, fostering intercourse and understanding among engineers. He humanized engineering and he broadened and dignified its function in our modern life.

The great engineering capability of Calvin Rice lay in his understanding of the role engineers and engineering should play in our modern advancing civilization. A stranger marveled that his list of honors, many of them foreign, recorded in "Who's Who in Engineering," should have come to an engineer with no great technical achievement; his achievement was the adjustment and coordination of engineering to life.

Rice had a friend at court, James Bertram, private secretary to our patron in early days. Long afterward, when a trustee of the Carnegie Corporation, he spoke in appreciation of Mr. Rice and said to me that the engineers' building "was the best gift Carnegie ever made."

The building, magnificent beyond the early vision, will obsolesce and pass away. But the new vitality and outlook and ideals engendered within its walls enrich the fruits of engineering through centuries to come.

CHARLES F. SCOTT

Following Mr. Scott's address, Mr. Lardner introduced C. E. Davies, Mr. Rice's successor as secretary of The American Society of Mechanical Engineers, who unveiled the tablet. Mr. Lardner then read the inscription on the tablet.

1868 1934

CALVIN WINSOR RICE

ERECTED IN APPRECIATION
OF A LIFE DEVOTED TO
THE ADVANCEMENT
OF THE PROFESSION
OF ENGINEERING AND OF
HIS
ACTIVE PART IN OBTAINING
FROM ANDREW CARNEGIE
THE GIFT OF THE
ENGINEERING SOCIETIES
BUILDING

DELEGATES AND COMMITTEEMEN HEAR MCBRYDE AND HANLEY

After the Rice Memorial Tablet had been dedicated, members of the Council met with the section delegates and members of standing committees at a luncheon at the Astor. A. J. Kerr, chairman of the Committee on Local Sections, presided and introduced members of the Council present.

Mr. McBryde spoke briefly of the opportunity for service that was facing the Society in the immediate future because of the emergency presented in the national-defense program. Engineers, he said, would have plenty to do, and the Society should seize the opportunity to build up its membership and its services.

W. A. Hanley, president-elect, said that he was entering upon his duties with great pleasure. He was deeply appreciative of the honor conferred upon him in the election and was confident that he would discharge the obligation of his office with dignity. The big task ahead, he said, was defense. We had to realize that we must deal with international gangsters, and he was certain that they would be dealt with with the only weapons they knew. It was a war of mechanization, he concluded, and it was the engineers' job to carry out the preparations for mechanization. It was his expectation to give extensively of his time to the work of the Society and he was confident that his administration would have the cooperation of all groups.

THE 1940 ANNUAL BUSINESS MEETING

The Annual Business Meeting of The American Society of Mechanical Engineers was held at the Astor immediately following luncheon on Monday. Mr. McBryde presided. C. E. Davies, secretary A.S.M.E., summarized the 1940 Annual Re-

AMONG THE 2530 MEMBERS AT THE ANNUAL MEETING

[(1) President Warren H. McBryde reports on Society affairs at Sunday meeting of Council and Committees. (2) Assistant Secretary Ernest Hartford tells a good one to A. J. Kerr while H. L. Eggleston and J. A. Keeth are disinterested. (3) Secretary C. E. Davies supplements the President's report at the Sunday meeting. (4) Management dinner on Monday evening. (5) At the Fuels Session. (6) Work Standardization Session, R. L. Morrow, speaker, distributed worksheets to audience on which to prepare ratio-delay study. (7) The various standing committees well represented at Sunday meeting. (8) C. H. Dolan, chairman of Aeronautic Division, presides at Aeronautic Dinner. (9) A candid shot at the Aeronautic Session. (10) Before each technical session, the authors gathered for breakfast, luncheon, or dinner. (11) The sign tells the story. (12) The Applied Mechanics Session had its quota of distinguished members.]

port of the Council (see pages 39–43 of this issue) and Col. J. J. Swan, chairman of the Finance Committee, presented the annual report of that committee (see pages 44–48 of this issue). A unanimous vote of approval of the "transactions of the Society's business during the year Oct. 1, 1939, to Sept. 30, 1940," was recorded.

The report of the tellers of election of officers was then read by the secretary as published in MECHANICAL ENGINEERING for November, 1940, page 837. The newly elected officers are:

To serve as managers for three-year terms.

HUBER O. CROFT, professor of mechanical engineering and head of the department at the University of Iowa, Iowa City, Iowa.

PAUL B. EATON, consulting engineer, and professor and head of the mechanical-engineering department at Lafayette College, Easton, Pa.

GEORGE E. HULSE, mechanical engineer, New Haven, Conn.

To serve as vice-presidents for two-year terms:

EDWIN B. RICKETTS, mechanical engineer with the Consolidated Edison Co. of New York, Inc., New York, N. Y.

FRANK H. PROUTY, partner in the Prouty Brothers Engineering Company and the Industrial Appraisal Company, Denver, Colo.

SAMUEL B. EARLE, dean of the School of Engineering, and director of the Engineering Experiment Station of Clemson Agricultural College, Clemson, S. C.

To serve as president for one year:

WILLIAM A. HANLEY.

Following the reading of the report, President McBryde declared the foregoing officers elected. (Biographical sketches of these officers will be found in MECHANICAL ENGINEERING, August, 1940, pp. 637–640.)

As chairman of the Committee on Local Sections, A. J. Kerr announced the personnel of the Nominating Committee as selected by the group conferences and approved by the Group Delegates Conference on December 1. The following members of the Nominating Committee were unanimously elected:

GROUP I: WILLIS F. THOMPSON, *representative*, Westcott & Mapes, Inc., 139 Orange St., New Haven, Conn.; E. S. DENNISON, *first alternate*, The Electric Boat Co., Groton, Conn.; R. A. NORTH, *second alternate*, Farrel-Birmingham Co., Ansonia, Conn.

GROUP II: E. J. BILLINGS, *representative*, Babcock & Wilcox Co., 85 Liberty St., New York, N. Y.; W. McC. McKEE, *alternate*, The M. W. KELLOGG Co., 225 Broadway, New York, N. Y.

GROUP III: A. L. KIMBALL, *representative*, General Electric Co., Schenectady, N. Y.; C. M. Merrick, 3RD, *first alternate*, Lafayette College, Easton, Pa.; S. T. HART, *second alternate*, Syracuse University, Syracuse, N. Y.

GROUP IV: N. C. EBAUGH, *representative*, Prof., Univ. of Fla., Gainesville, Fla.; C. E. KERCHNER, *first alternate*, 23 W. 14th St., Denim Sta., Greensboro, N. C.; H. S. KENT, *second alternate*, 1909 Wellington Rd., Homewood, Md.

GROUP V: H. B. JOYCE, *representative*, 616 Commerce Bldg., Erie, Pa.; C. J. FREUND, *alternate*, Dean, University of Detroit, Detroit, Mich.

GROUP VI: R. E. TURNER, *representative*, *Power Plant Engineering*, 53 West Jackson Blvd., Chicago, Ill.; C. C. WILCOX, *first alternate*, Notre Dame University, Notre Dame, Ind.; C. A. Jacobson, *second alternate*, 1107 Brewster Ave., Beloit, Wis.

GROUP VII: EARL MENDENHALL, *representative*, Sterling Motors, Inc., 5401 Telegraph Rd., Los Angeles, Calif.; H. L. DOOLITTLE, *first alternate*, So. Calif. Edison Co., 601 W. 5th St., Los Angeles, Calif.; W. H. CLAPP, *second alternate*, California Institute of Technology, Pasadena, Calif.

GROUP VIII: L. J. Lassalle, *representative*, Louisiana State University, University, La.; W. H. CARSON, *first alternate*, College of Engineering, University of Oklahoma, Norman, Okla.; A. L. HILL, *second alternate*, 1033 Humboldt St., Denver, Colo.

At the first meeting of the committee, A. L. Kimball was elected chairman, E. J. Billings, vice-chairman, and N. C. Ebaugh, secretary.

There being no further scheduled business, I. E. Moultrop, of Boston, Mass., rose to renew his objection, voiced at the 1939 meeting, to holding the A.S.M.E. Annual Meeting outside the Society's headquarters, and Mr. McBryde and Erik Oberg, chairman of the Committee on Meetings and Program, commented briefly on the reasons for the change.

Just before adjournment, John Clinton Parker, of Washington, D. C., addressed the meeting on the subject of his controversies with the Society.

MEETINGS OF THE A.S.M.E. COUNCIL

The Annual Meeting of The American Society of Mechanical Engineers was a busy time for the Council of the Society. Its Executive Committee met on Sunday, and on Monday the full Council met at the Society headquarters, adjourning until Friday morning when it wound up the business of the 1940 administrative year and reconvened as the Council for the 1941 administrative year, under the leadership of its new president, William A. Hanley.

At the Council meeting on Monday morning there were present Warren H. McBryde, president; Harvey N. Davis and Alexander G. Christie, past-presidents; Alfred Iddles, James W. Parker, Kenneth H. Condit, Francis Hodgkinson, J. C. Hunsaker, and K. M. Irwin, vice-presidents; Carl L. Bausch, Samuel B. Earle, Frank H. Prouty, Clarke Freeman, William H. Winterrowd, Willis R. Woolrich, Joseph W. Eshelman, Linn Helander, and Guy T. Shoemaker, managers; C. E. Davies, secretary; Edwin B. Ricketts, vice-president-elect; Huber O. Croft and George E. Hulse, managers-elect; R. L. Sackett (Admissions), Joseph W. Roe (Board of Honors and Awards); J. J. Swan (Finance); A. J. Kerr (Local Sections), Harte Cooke (Professional Divisions); C. B. Peck (Publications), Eugene W. O'Brien (Relations With Colleges), L. W. Wallace (Research), and C. J. Freund (Economic Status of the Engineer), representatives of committees; Walter W. Lawrence, junior observer; L. E. Jermy and F. L. Yerzley, members of the Society; and W. R. Woolrich, Jr., guest. Communications of regret from W. Lyle Dudley and James H. Herron were read.

At the afternoon session there were present, in addition to those already mentioned, H. L. Eggleston and J. N. Landis (Local Sections), and S. Logan Kerr (Committee on Consulting Practice). Messrs. Cooke, O'Brien, Peck, and Swan did not attend the afternoon session.

COMMITTEE REPORTS

The Annual Report of the Council was presented and adopted by vote. (This report will be found on pages 39–43 of this issue.) Reports of the standing and special committees were also presented and adopted. (These reports are available on request at the Secretary's offices.) The Annual Report of the Woman's Auxiliary was presented and accepted with appreciation.

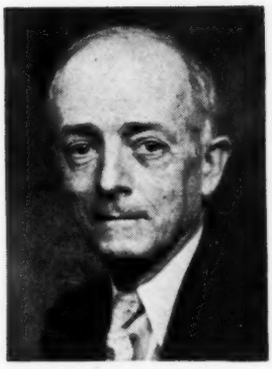
REPORT OF THE SECRETARY

At the request of the president, C. E. Davies, secretary, reported informally on the progress that had been made in respect to suggestions presented by him at the 1939 Annual Meeting.

Good progress has been made in improving the technical work of the Society. The enlarged Board on Technology, in addition to dealing with problems that have been assigned to it, has taken the initiative in stressing the need for cooperation between the Professional Divisions on the one hand and on the

SAMUEL. B. EARLE

FRANK H. PROUTY



EDWIN B. RICKETTS

Vice-Presidents

HUBER O. CROFT

PAUL B. EATON

GEORGE E. HULSE

Managers

New Members of 1941 A.S.M.E. Council

other, the Research Committees, the standardization committees, and other engineering Societies. The Standing Committee on Research has stated a forword-looking program which provides definite responsibilities for the Professional Divisions. The Council has been generous in providing funds for a new staff man to aid on the Divisions work, for the services of W. H. Carson for the Petroleum Division, and for new activities of the Aeronautic and Management Divisions. The worth-while activities thus started should bear fruit during the coming year.

The membership situation was being given further study. As the report of the Council showed, there had been no growth in the senior grade of membership. The problem facing the Society was that of bringing leaders into active membership and of securing a greater number of promotions from the Junior grade.

The Nominating Committee, he said, had been studying the problem of selecting members of the Council on a geographical basis, which had resulted, in some cases, in the election of members for a short two-year term on the Council with subsequent loss of the services of efficient men who were not available for longer terms. It was important, he said, that the problem be given careful thought from the standpoint of continuity of service on the Council.

There was a real opportunity, Mr. Davies pointed out, to improve the Society's technical and educational relationships with other societies that serve the broad field of mechanical engineering.

In the discussion of the Secretary's report, which followed Mr. Davies' presentation, the fact was emphasized that the activities, procedures, and policies of the Society should be transmitted in detail, wherever possible, to the delegates of the local sections, who did not always appear to be correctly or completely informed on these matters.

LEADERSHIP IN PROFESSIONAL DIVISIONS

An informal report of the Committee on Leadership in Professional Divisions was submitted by Alfred Iddles, chairman. This committee was organized in June, 1940, "to study and report to the Council the various methods of increasing the prestige of leadership in the A.S.M.E. professional divisions." In view of the fact that the Society's principal activities are of a technical nature, it had been thought that there might be technical as well as geographical representation on the Council. Such a result might be secured if the Nominating Committee were properly informed of the Society's problems. Mr. Iddles made no formal recommendation, as any specific action would require careful consideration and constitutional changes should not be made frequently or rapidly. The Council voted to continue the committee and to enlarge its scope to include consideration of Council organization.

In view of the secretary's report, the Council voted to ask the Committee on Relations With Colleges to work out a scheme of coordination with the Committee on Professional Divisions.

COUNCIL MEMBERS REPORT

Fifteen members of the Council reported visits made to local sections and student branches. For the most part, they reported, conditions were healthy and excellent meetings and conferences were being held. Several members, in commenting on visits to the local-section group conferences, noted that the subjects for discussion were ambiguously worded and were repeated from year to year, and that the delegates were not informed concerning the problems involved. It was suggested that committee reports and other material be distributed well in advance and that delegates be required to review the material before attending the conferences. Mr. McBryde expressed his appreciation of the Council members who had represented him so ably and gave a brief résumé of the visits he had made to local sections and student branches.

PETROLEUM DIVISION REPORT

A report of the Petroleum Division covering its future plans was received with expressions of appreciation.

LOCAL SECTIONS

For the Committee on Local Sections, A. J. Kerr, chairman, reviewed the committee's annual report in which were incorporated not only matters of record but of future policy as well. A special report, requested by the Council in June, 1940, covering an analysis of the problems of the junior engineers, was presented by Walter W. Lawrence, the chairman of the subcommittee set up for that purpose.

Mr. Kerr reported informally on the progress and plans of the Membership Development Committee, and made recommendations regarding certain financial adjustments which the Council referred to the Finance Committee.

AMENDMENT TO BY-LAWS ADOPTED

The Council voted to adopt changes in Article B6A, Par. 24, to read as follows:

"The Standing Committee on Research shall, under the direction of the Council, have supervision of the research activities of the Society. The Committee shall consist of five (5) members and the term of one (1) member shall expire at the close of each Annual Meeting."

It also voted to amend R5 Rule 2 (Fees and Dues) to read as follows:

"The Student-member may pay an initial quarter-year's dues, $2.50, to indicate acceptance of election. If he chooses this method, the remaining three quarters of the dues, $7.50, shall be due not later than the first of the month following a three-months' period thereafter. If he follows this procedure he will receive publications for the periods paid but no other services until election is accepted by payment of the full-year's dues. If he does not accept or follow this procedure and complete his payments before September 30 of the calendar year following the calendar year in which he was graduated, the automatic scheme of transfer without initiation fee expires and thereafter he must make a new application for Junior membership and if elected pay an initiation fee of $10."

MEETING OF DECEMBER 6

Monday's meeting of the Council was reconvened on Friday, Dec. 6, 1940, in the Society's rooms, by President McBryde. There were also present: Harvey N. Davis and Alexander G. Christie, past-presidents; Alfred Iddles, James W. Parker, Kenneth H. Condit, Francis Hodgkinson, and K. M. Irwin, vice-presidents; Samuel B. Earle, Clarke Freeman, William H. Winterrowd, W. R. Woolrich, Joseph W. Eshelman, Linn Helander, and Guy T. Shoemaker, managers; C. E. Davies, secretary; William A. Hanley, president-elect; Edwin B. Ricketts, vice-president-elect; Huber O. Croft, Paul B. Eaton, and George E. Hulse, managers-elect; R. L. Sackett and H. E. Mole (Admissions); S. R. Beitler (Constitution and By-Laws), A. J. Kerr, H. L. Eggleston, F. W. Marquis (Local Sections); A. R. Mumford, B. V. E. Nordberg, and O. B. Schier, 2nd (Delegates); W. J. Wohlenberg and A. L. Kimball (Meetings and Program); N. C. Ebaugh (Nominating Committee); Harte Cooke (Professional Divisions); Eugene W. O'Brien and James D. Cunningham (Relations With Colleges); L. W. Wallace (Research); John L. Hall (Junior Observer); R. L. Daugherty; and Ernest Hartford, assistant secretary.

CONSTITUTION AND BY-LAWS CHANGES

The Council voted to receive proposed changes in Article B9, whereby Par. 1 will be deleted, and present paragraphs 2 through 6 will be renumbered paragraphs 1 through 5, for action at the next Council Meeting.

The Council also voted to approve for references to the Business Meeting to be held in Kansas City, June, 1941, an amendment to Article C3, by adding the following section 4:

"A member who violates the Code of Ethics (B15) or whose conduct is such as to make him unfit for membership in the Society, may be expelled by the affirmative vote of fifteen (15) members of the Council. Such vote shall be taken only upon report of a committee of members appointed to hear the accusation and defense, recommending such expulsion."

A.I.E.E. MODEL REGISTRATION LAW

Action on a report by the Special Committee on Registration on the A.I.E.E. Model Law was deferred until the next meeting of the Council.

RESEARCH COMMITTEE REPORTS

L. W. Wallace, chairman of the Committee on Research, presented a revision of the report submitted to the Council at its meeting in Milwaukee. The revised report differs from the original only in the manner of implementing the details, primarily those relating to financial phases of research. In presenting the report Mr. Wallace emphasized the fact that if the Society expects to accomplish anything in the field of research, the committee must have more administrative assistance. The revised report was approved.

BOARD ON TECHNOLOGY

Alfred Iddles, chairman of the Board on Technology, reviewed the work of the Board. He reported that the principal problem of the Committee on Publications revolved around the activities of the Applied Mechanics Division and the *Journal of Applied Mechanics*. A recommendation would be forthcoming at a later date, he said.

Active cooperation between the Committee on Research and the professional divisions had been initiated, Mr. Iddles reported, as a result of which the divisions were appointing, and in some cases had appointed, research secretaries. It was felt, he added, that the divisions should refer to the Committee on Research all potential research projects, and that they should take the initiative in surveys of needs of their fields in an effort to discover additional research projects. Some recognition of the newly appointed research secretaries was called for, and on the recommendation of the Board on Technology, the Council voted to authorize the appointment of the research secretaries of the professional divisions as associate members of the Committee on Research.

QUESTIONS RELATING TO NATIONAL DEFENSE

The Council took action on several matters relating to national defense. It passed a vote which will make it possible for

student members who spend a year in military service to have extended by one full year, during which time no dues would be payable, the date of transfer to junior membership. Upon recommendation of the Committee on Meetings and Program it authorized the holding of a meeting of interested divisions on national defense at some suitable place during the spring. It further authorized distribution of the 1940 Annual Dinner address of Past-President William L. Batt to all local sections, through the Committee on Local Sections, with an accompanying communication stressing the importance of the address and with suggestions for national-defense meetings which local sections are urged to hold.

EMPLOYEE'S PENSION FUND

The Finance Committee submitted recommendations and figures for an employee's pension fund based on the plan in operation in the American Society of Civil Engineers, and recently adopted by the United Engineering Trustees, Inc., and was authorized to work out the plan in greater detail with the assistance of actuarial experts.

SECRETARY'S LEAVE OF ABSENCE

President McBryde announced that the Ordnance Department had requested the return of Secretary Davies to active service for nine months, beginning January 1, 1941. W. H. Winterrowd presented a joint recommendation of the Finance Committee and the Special Committee on Society Office Operation relating to matters involved in the proposed leave of absence, and this recommendation was referred to the 1941 Council. (The 1941 Council subsequently granted the nine months' leave of absence and approved certain administrative arrangements necessitated by it.)

GROUP DELEGATES CONFERENCE

A. R. Mumford, representing A. R. Acheson, Speaker for 1940 Conference of Group Delegates, presented informally the recommendations and actions of the Conference.

Attention was called to the fact that the delegates spent a full two and a half days discussing the items prepared by the Agenda Committee from lists of questions raised by the local sections. To avoid repetition, the Conference passed a resolution to the effect that previous questions will not be reconsidered unless requested by at least three local sections. The Conference definitely favored recognition of student branches only in colleges recognized by the Engineers' Council for Professional Development. The matter of reorganization of the Society was discussed at length. The delegates reported that there was a general feeling of uneasiness in the membership regarding the future of the Society, a feeling not so much of criticism of what the Society had done, but a feeling rather that something *new* must be done by the Society to offset the trend to the formation of small separate societies to cover specialized subjects.

The Conference endorsed the definition of the Fellow grade as given in the report of the Committee on Admissions, published in the September, 1940, issue of MECHANICAL ENGINEERING. Since there is an inherent reluctance on the part of eligible members to make application for that grade, the Conference has made specific recommendations for such applications, the details of which will appear in the minutes of the Conference to be sent to the Council. R. L. Sackett, representing the Committee on Admissions, reported that he had attended the session of the delegates at which the Fellow grade was discussed. Much time was devoted to this problem and he believed a rational solution had been worked out which would help materially in clarifying the procedure for submitting applications for that grade. He believed the recommendation would be equally applicable to those in the Junior grade who are eligible for promotion to full membership.

After hearing the report the Council voted to receive it with sincere appreciation, and instructed the Secretary to transmit the various recommendations to the committees involved, for necessary action and for report of their actions to the Council. It referred to the Committee on Admissions and its advisory committee the recommendations that had been made relating to the Fellow grade.

NATIONAL-DEFENSE PROGRAM

A resolution of the Fuels Division was approved and its conveyance through the Special Committee on National Defense to the proper governmental authorities was authorized.

The resolution follows:

WHEREAS, The United States of America is engaged in an unprecedented national-defense program, and

WHEREAS, our country should conserve all its natural resources including fuels, and

WHEREAS, the membership of the A.S.M.E. includes many of the outstanding fuel and combustion engineers in the country, therefore, be it

Resolved, that The American Society of Mechanical Engineers offer the services and professional talents of our members to our government in the interests of the efficient utilization of fuels and the conservation of our fuel resources.

RETIRING MEMBERS OF COUNCIL THANKED

Business of the 1940 Council having been completed, it was voted to extend to the retiring members of the Council (past-president Ralph E. Flanders, vice-presidents W. Lyle Dudley, Alfred Iddles, and James W. Parker; and manager Carl L. Bausch) thanks and appreciation for their services. The Council also recorded its sincere appreciation to the retiring president, Warren H. McBryde. Mr. McBryde responded by expressing his thanks to his colleagues for their unselfish loyalty and splendid cooperation during his administration, and the 1940 Council adjourned.

1941 A.S.M.E. COUNCIL CONVENES

Warren H. McBryde, president of The American Society of Mechanical Engineers during 1940, introduced the new members of the 1941 Council as follows: Managers Huber O. Croft, Paul B. Eaton, and George E. Hulse; Vice-Presidents Samuel B. Earle, Frank H. Prouty, and Edwin B. Ricketts; and President William A. Hanley, and presented the "President's gavel" to Mr. Hanley, who took the chair and called the 1941 Council to order.

APPOINTMENTS

C. E. Davies was reappointed Secretary for the year ending with the 1941 Annual Meeting and W. D. Ennis was reappointed treasurer for the same period.

Upon nomination of the president, the following were appointed to serve as the Executive Committee of the Council for the administrative year 1941: William A. Hanley, chairman; Kenneth H. Condit, Clarke Freeman, K. M. Irwin, and W. H. Winterrowd.

Presidential appointments to standing and special committees were confirmed.

Various special committees whose work was not completed were continued and the following special committees were discharged with thanks: Aims and Objectives, Education, and Manual of Practice.

TWENTY-FIFTH ANNIVERSARY COLORADO SOCIETY OF ENGINEERS

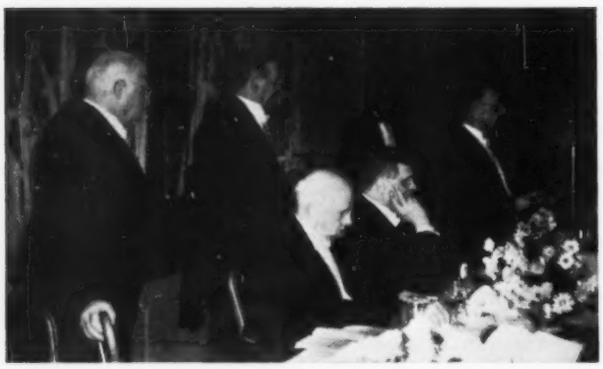
The Council voted to extend a resolution of congratulations to the Colorado Society of Engineers on the occasion of the

PRESIDENT MCBRYDE ADDRESSES THE ANNUAL DINNER

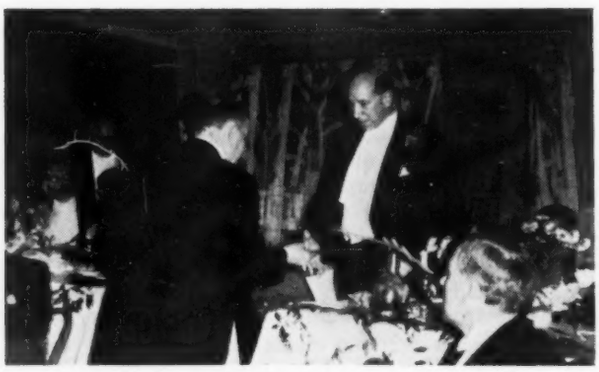
WILLIAM L. BATT TOASTMASTER AT ANNUAL DINNER

AT THE ANNUAL DINNER THE HONORS TABLE WAS BEHIND THE SPEAKERS

TWO SHOTS WERE NECESSARY TO GET IN ALL THE MANY DIGNITARIES



ARTHUR M. GREENE, JR., MADE HONORARY MEMBER

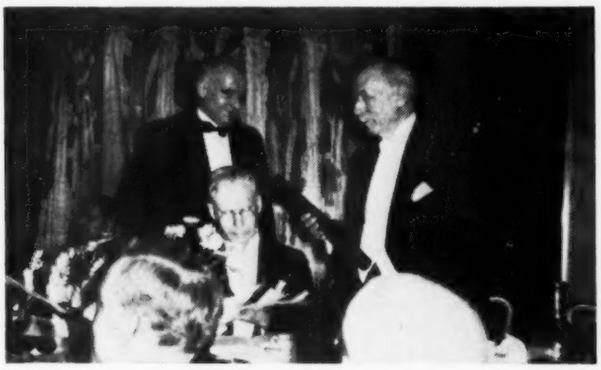


CARL BRANDT RECEIVING THE MELVILLE MEDAL

PI TAU SIGMA AWARD WAS WON BY GEORGE A. HAWKINS

PRESIDENT MCBRYDE GREETS MEDALIST ROWAN

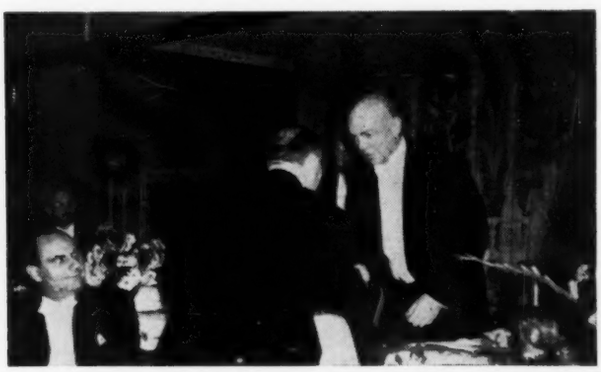
J. W. ROE READS PROFESSOR GREGORY'S CITATION



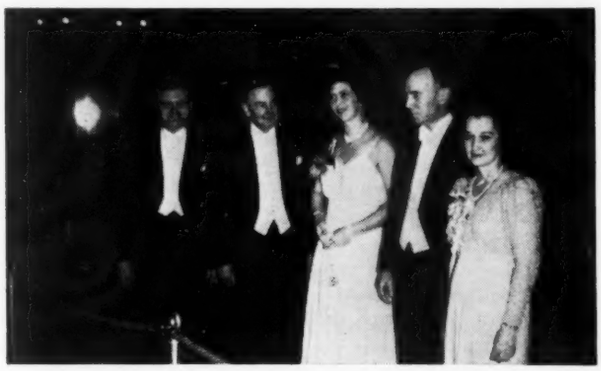
ALBERT KINGSBURY HOLDING CERTIFICATE OF HONORARY MEMBERSHIP

IN THE FOREGROUND—A.S.C.E. SECRETARY GEORGE T. SEABURY AND MRS. SEABURY

LISTENING TO THE PRESIDENT'S ADDRESS



MAJOR ARMSTRONG RECEIVES THE HOLLEY MEDAL



THE RECEIVING LINE—C. E. DAVIES, PRESIDENT MCBRYDE, MISS MCBRYDE, PRESIDENT-ELECT HANLEY AND MRS. HANLEY

twenty-fifth anniversary of its founding, and designated Frank H. Prouty honorary vice-president to represent the Society at the exercises.

CONFERENCE OF GROUP DELEGATES

For the purpose of providing an opportunity for wide and responsible discussion of Society affairs, problems, and policies, the Local Sections of the A.S.M.E. conduct every fall a series of conferences of delegates of the sections. Eight of these conferences were held in the fall of 1940, one in each of the eight geographical areas into which the local sections are divided for purposes of adminstration. Each of these eight groups is represented at a Conference of Group Delegates, held in New York at the time of the Annual Meeting, by two representatives, making a total of 16 delegates. These delegates carry instructions and resolutions from the group conferences, and discuss in the Conference of Group Delegates whatever business has been provided for them or seems appropriate. The Conference is presided over by a speaker, who was A. R. Acheson, of Syracuse, at the 1940 meeting. It organizes into committees to expedite its business and renders a report of its deliberations to the Council. Delegates are elected to serve for two years, and elections are made so that one new delegate for each group comes to the conference while the second delegate from that group is serving his second term of office.

DELEGATES TO 1940 CONFERENCE

The delegates at the 1940 Conference were as follows:

GROUP I: L. H. Von Ohlsen, New Haven, Conn., New Haven Section; A. D. Andriola, New London, Conn., Norwich Section.

GROUP II: O. B. Schier, 2nd, New York, N. Y., Metropolitan Section; A. R. Mumford, New York, N. Y., Metropolitan Section.

GROUP III: A. R. Acheson, Syracuse, N. Y., Syracuse Section; J. S. Morehouse, Villanova, Pa., Philadelphia, Section.

GROUP IV: A. D. Asbury, Greenville, S. C., Greenville Section; F. C. Smith, Atlanta, Ga., Atlanta Section.

GROUP V: H. M. Gano, Dayton, Ohio, Dayton Section; and C. T. Oergel, Erie, Pa., Erie Section.

GROUP VI: B. V. E. Nordberg, Milwaukee, Wis., Milwaukee Section; R. A. Cross, Davenport, Iowa, Tri-Cities Section.

GROUP VII: W. D. Turpin, Salt Lake City, Utah, Utah Section; A. D. Hughes, Corvallis, Oregon, Oregon Section.

GROUP VIII: H. L. Crain, Kansas City, Mo., Kansas City Section; C. W. Crawford, College Station, Texas, South Texas Section.

The following committees were appointed to expedite the work of the conference:

Agenda: O. B. Schier, 2nd, chairman; J. S. Morehouse, F. C. Smith, and C. T. Oergel.

Membership: A. D. Asbury, chairman; R. A. Cross, A. D. Hughes, and C. W. Crawford.

Budget: H. M. Gano, chairman; A. R. Mumford, and H. L. Crain.

Organization: W. D. Turpin, chairman; B. V. E. Nordberg, and A. D. Andriola.

In the absence of G. R. Truedsson, the speaker appointed L. H. Von Ohlsen to act as secretary of the Conference. J. S. Morehouse acted as secretary until the arrival of Mr. Von Ohlsen.

The Conference submitted an extensive report of its deliberations to the Council which, as reported elsewhere, referred the individual items of the report to the appropriate committees of the Society for consideration and report. Because he found it impossible to be present at the Friday meeting of the Council, the Speaker appointed Messrs. Schier, Mumford, and Nordberg to represent him and present his report. Mr. Acheson's report follows:

SPEAKER'S REPORT TO THE COUNCIL

Following the usual custom the speaker of the Conference of Group Delegates is pleased to present to Council a brief summary of the high lights of the Conference of the Group Delegates.

For a full two and a half days the delegates discussed items prepared by the Agenda Committee from lists of questions raised by the local sections.

Since all members of The American Society of Mechanical Engineers cannot attend these conferences, questions answered in previous conferences keep recurring and valuable time is apparently wasted rediscussing them. Our conference has passed a resolution to the effect that old questions will not be reconsidered unless requested by at least three local sections. This should save useless discussion but still leave sections free to arrange for renewed discussion of old topics if they so desire and can get two other sections to come along with them.

The Conference definitely favored recognition of Student Branches only in colleges recognized by E.C.P.D.

The annual "Battle of the Budget" was staged as usual, but with the best of feeling, all members being good engineers and recognizing that we should not spend what we don't have, but all nevertheless hoping that Council might see a way clear to allot more financial aid to local sections, especially to the smaller sections.

Perhaps the longest discussion arose over the agenda item stating that the Society should be reorganized. The action of the Conference speaks for itself. The speaker would simply add that the delegates reported that there was a general feeling of uneasiness in the membership regarding the future of the Society, a feeling not so much of criticism of what the Society had done, but a feeling that something *new* must be done by the Society to offset the trend to the formation of small separate societies to cover specialized subjects.

The delegates were pleased to learn that Council was actively at work on the question of engineer-unions, employer-employee relationship, and similar topics. The delegates were acutely aware of the necessity for action in these matters and look to Council for guidance on the proper policy to follow.

OFFICERS FOR 1941 CONFERENCE

The nominating committee of the Conference reported nomination of the following officers for the 1941 Organization Committee:

Speaker, A. R. Mumford; vice-speaker, F. C. Smith; secretary, A. D. Hughes; budget, C. T. Oergel; membership, A. D. Andriola; agenda, J. S. Morehouse; miscellaneous, R. A. Cross; and organization, C. W. Crawford.

These officers were elected by the Conference.

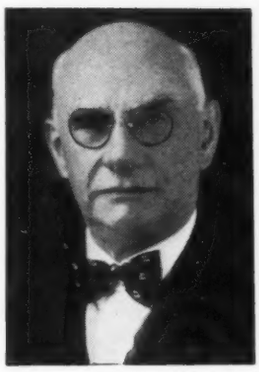
It is customary for the Council to report its actions on the suggestions of the Conference of Group Delegates Conference as soon as recommendations are received by the committees of the Society to which they have been referred. These actions are subsequently printed in MECHANICAL ENGINEERING.

ANNUAL DINNER FOR MEMBERS

It has been many years since the A.S.M.E. Annual Dinner in New York City for Members has attracted such a large number of persons. This year it was found necessary to set tables in the balconies of the Grand Ball Room of the Hotel Astor. Such, however, was the case at the 1940 dinner with its attendance of nearly one thousand.

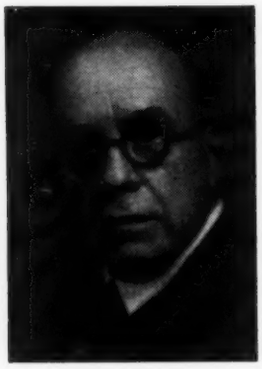
Following a recent practice, Honors Night was combined with the dinner this year, and an honors table was set directly behind and slightly higher than the speakers' table. Harvey N. Davis, past-president of the Society, acted as toastmaster. Following the serving of the meal the entire audience joined in the singing of the national anthem, led by Miss Eleanor Eberhardt, of Philadelphia, Pa., with Leslie N. Leet at the organ.

Seated at the speakers' table, in addition to the toastmaster,



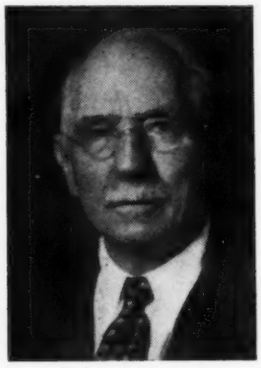
W. L. ABBOTT

R. W. ANGUS



J. A. SEYMOUR

A. M. GREENE, JR.



ALBERT KINGSBURY

Made Honorary Members of the A.S.M.E.

President McBryde, and President-Elect Hanley, were Wm. L. Batt, past-president, A.S.M.E., who delivered the principal address, and guests representing other national societies, as well as several A.S.M.E. past-presidents, all of whom were introduced to the audience amid applause. Mr. McBryde read the names of those who had become "Fifty-Year Members of the A.S.M.E." since the 1939 Annual Meeting, and presented the Fifty-Year badges to the three who were present: D. C. Jackson, F. M. Towl, and A. E. Johnson. The other Fifty-Year Members, who were not present, were Bert L. Baldwin, Albert Harlan Bates, W. W. Dashiell, Chester H. Davis, Robert Dawes, George E. Hunter, Arthur George Leonard, and Edwin C. Shaw.

From various parts of the room, as their classes were called, there stood to acknowledge the applause, the thirty-fivers, the forty-year men, the forty-fivers, and the fifty-year men, and one, Edward Needles Trump, who has been a member sixty years.

Mr. McBryde then recognized J. W. Roe, chairman of the Board on Honors and Awards, who presented the 1940 medalists and newly elected honorary members. Past-President Roy V. Wright and Council Member Carl L. Bausch, escorted the recipients of honors to the center of the platform for the introductions, and Mr. McBryde handed to each the medal or certificate he had been awarded. The medalists were as follows:

Undergraduate Student Award to Edward D. Rowan for his paper, "Powder Metallurgy."

Postgraduate Student Award to George W. Shepherd, Jr., Princeton University, for his paper, "An Automatic Mechanical Control for Synchronizing Prime Movers."

Charles T. Main Award to Frank DePould, Case School of Applied Science, for his paper, "What Has Been the Effect of Technological Advance on Employment?"

Pi Tau Sigma Medal to George A. Hawkins, Purdue University, awarded to an engineering graduate of both accomplishment and promise, who is not more than ten years out of college.

Junior Award to Robert E. Newton, Washington University, for his paper, "A Photoelastic Study of Stresses in Rotary Disks."

Melville Medal to Carl A. W. Brandt, New York, N. Y., for his paper "The Locomotive Boiler" read at this meeting a year ago. Educated in Sweden and trained there as a locomotive engineer, said Mr. Roe in introducing the medalist, Mr. Brandt gained extensive knowledge of American railway motive power in service on several lines in this country. His present work, in which he has advised on and checked the designs of practically every locomotive built in the United States during the last 25 years, has provided the authoritative knowledge upon which his paper was based.

Worcester Reed Warner Medal to William Benjamin Gregory, New Orleans, La., past vice-president of the Society and member since 1895 "for distinguished work in hydraulic engineering." An educator, who has taught engineering with distinction at Tulane University for 46 years, his skill and knowledge as an engineer have long been utilized by the federal government on the problems of the lower Mississippi River.

Holley Medal to Edwin H. Armstrong, New York, N. Y., "for his leadership in the field of radio communication." Authority on electrical circuits and pioneer in the field of wireless telephony, he has made basic improvements in the radio.

EDWARD D. ROWAN

G. W. SHEPHERD, JR.

FRANK DEPOULD

(Mr. Rowan of Oregon State College received the Undergraduate Student Award for his paper "Powder Metallurgy;" Mr. Shepherd, of Princeton University, the Postgraduate Student Award for his paper "An Automatic Mechanical Control for Synchronizing Prime Movers;" and Mr. DePould, of Case School of Applied Mechanics, the Charles T. Main Award for his paper "What Has Been the Effect of Technological Advance on Employment.")

His inventions have provided employment to many hundreds in the manufacture of receiving sets, and brought enjoyment to untold thousands in their use.

Certificates of honorary membership were then presented to the following, with appropriate remarks on the career of each by Mr. Roe:

James A. Seymour, member since 1892, designer and builder of engines. He had the daring, upon graduation from college, to begin with a classmate the manufacture of steam engines of his own design. Within five years he was one of the world's leading builders of reciprocating steam engines for use in the generation of electric power. In his hands this type of engine reached its highest development. When it was superseded by the steam turbine he turned his talents to the Diesel engine and made his company one of the leaders in this field.

Albert Kingsbury, A.S.M.E. medalist in 1931 and member since 1892: Engineer, inventor, manufacturer, and student of the mechanics of lubrication, who has spent a lifetime preventing waste and destruction from friction, by the supporting of huge masses of machinery on thin films of oil, and has provided for hydraulic turbines and other weighty mechanisms the remarkable bearing known by his name.

Arthur Maurice Greene, Jr., past vice-president and member since 1895: Distinguished teacher, and son of a distinguished teacher, he has influenced engineering education in the University of Pennsylvania, the University of Missouri, Rensselaer Polytechnic Institute, and Princeton University. Textbooks on a wide range of subjects and many years of service on the Society's technical committees show the breadth of his engineering interests. The influence of his teaching blends technology with culture and leads from knowledge, to wisdom.

Robert W. Angus, past vice-president and member since 1901: Citizen of Canada, our neighbor now engaged with the British Empire in the preservation of its own liberties and those of all free men; professor of mechanical engineering at the University of Toronto; consultant on hydroelectric power; pioneer in the use of models for the study of water flow and elimination of ice troubles in hydraulic plants. In electing him Honorary Member we join with our sister society, The Engineering Institute of Canada, which has already similarly honored him.

William Lamont Abbott, past-president and member since 1891: Lifelong leader in the development of the steam power station. He has greatly increased the efficiency of combustion and has seen reciprocating steam engines grow to enormous size and then be superseded by still more powerful steam turbines. Under his leadership energy has spread from the limits of a single city block to every corner of a great city, to its surrounding communities, and to remote rural areas. He is outstanding as a citizen as well as an engineer, and for many years has been president of the Trustees of the University of Illinois.

Mr. Seymour was unable to be present at the dinner because of illness, and Charles F. Kettering, who had been awarded the A.S.M.E. Medal, was detained in Washington.

Biographical sketches of the medalists and honorary members were printed in the dinner program.

Following the ceremony of awards, Miss Eberhardt sang to the organ accompaniment by Mr. Leet, and the toastmaster introduced Harte Cooke, chairman of the Old Guard, a group of men whose long years of membership in the Society relieves them from further dues payment, and whose generosity makes possible the attendance of certain student members at the dinner.

MCBRYDE REVIEWS WORK OF SOCIETY

Mr. McBryde took for the title of his presidential address, "Our Society After Sixty Years." He presented a comprehensive picture of the Society as it exists today by citing figures on membership, committee activities, financial affairs, and the accomplishments of the last year. In closing he said:

> Our Society has accomplished much. Our Society can and must accomplish more. Our Society today faces greater opportunities for service than it has ever yet known. The new, unseen, unknown prob-

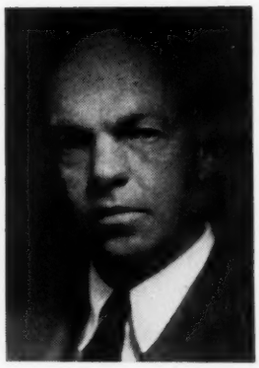
GEORGE A. HAWKINS

R. E. NEWTON

(Mr. Hawkins of Purdue University received the Pi Tau Sigma Medal for significant achievements in high-pressure steam research and engineering education; Mr. Newton of Washington University, the Junior Award for his paper "A Photoelastic Study of Stresses in Rotary Disks.)

C. A. W. BRANDT

W. B. GREGORY



E. H. ARMSTRONG

(Mr. Brandt received the Melville Medal for his paper "The Locomotive Boiler;" Professor Gregory the Worcester Reed Warner Medal for distinguished work in hydraulic engineering; and Mr. Armstrong the Holley Medal for his leadership in the field of radio communication.)

lems, emergencies, crises, and perhaps catastrophies that will be ours to solve will call for the very best professional skill, ability, ingenuity, and resourcefulness that we possess and can develop.

This is especially so in solving our national-defense program—its planning, its construction, and its operation, against time—to defend our country in time. This, so far, is a mechanized war—on land, sea, and in the air. All are problems of the mechanical engineer. It is our responsibility to show what we are made of personally and professionally, individually and as members of, and as a society of, mechanical engineers.

We have the opportunity to acquit ourselves with the highest professional skill with dignified and determined ability. We must overcome all obstacles.

We must get results. Invention, experimentation, research, and above all, production must be quickened.

We must meet these problems.

We must solve them quickly.

We must be successful.

When he had completed his survey of the Society as it is today and of the immediate future, Mr. McBryde introduced President-Elect William A. Hanley, who spoke briefly in acknowledgment of the applause and pledged himself to carry on the work of his predecessors in his conduct of the affairs of the Society during the coming year. After the newly elected members of the Council had been introduced, Mr. McBryde turned the chair back to Dr. Davis, who presented Past-President Wm. L. Batt, speaker of the evening. Mr. Batt's address, "Through a Glass, Darkly," was a timely warning against complacency in the national-defense effort and a plea for the establishment of an independent agency whose responsibility it would be to prepare a peacetime mobilization plan in an effort to alleviate the most serious consequences of postwar adjustments. Mr. Batt's address will be found on pages 5–8 of this issue.

CHAS. F. KETTERING

JOSEPH W. ROE

(Mr. Kettering was awarded the A.S.M.E. Medal for outstanding inventions and research; Professor Roe introduced and presented to the president the various medalists as well as those receiving honorary membership in the A.S.M.E.)

While the ballroom was being cleared for dancing, the Secretary, President McBryde, Miss McBryde, and President-Elect and Mrs. Hanley received in the adjoining Coral Room. Dancing followed until 2 a.m.

SPECIAL LUNCHEONS

A number of special luncheons were held during the week of the meeting at which opportunity was provided for the delivery of brief addresses. Mention has already been made of the luncheon on Monday at which the president and president-elect spoke. Tuesday's luncheon was held jointly by the A.S.M.E. and the Society for the Promotion of Engineering Education, with Geo. L. Tuve, member A.S.M.E. and chairman of the mechanical division of the S.P.E.E., of the Case School of Applied Science, as toastmaster. The speaker was K. W. Jappe, member A.S.M.E., director of purchases, Hercules Powder Co., Inc., Wilmington, Del., whose subject was "Economics for the Engineering Student." Mr. Jappe reviewed a number of common-sense principles and developed lines of thought that he had frequently used in speaking before groups of engineering students.

Mr. Jappe contended that the financial history of most persons and businesses was that they laboriously accumulated a surplus over a period of years only to have it swept away periodically through ignorance of some rather simple things. These things could be taught and assimilated by the average intellect and could be expressed in everyday language.

The essence of the thing lay in timing. There was a right time and a wrong time to go into business, to expand plant, to accumulate stocks of commodities, to use credit, and to buy or sell a house or securities. Studies of the causes of growth of large fortunes had shown that a great increase in holdings of fixed assets always had taken place in times of general financial distress. It was easy to see that things were cheap at such times but the question was always, "What shall we use for money?" If one wanted to have money when it was hard to get, it would be necessary to lay it aside when it was easy to get. These things did not lend themselves to precise mathematical determination. Timing was more important than technical perfection. Everything centered around an understanding of the business cycle and the means of estimating one's current position in that cycle. Manufacturers tended to expand in a boom, to carry things to extremes, to misuse credit.

Failures were principally due to lack of familiarity with a

few fundamental concepts. The most important of these was the business cycle and its causes and effects. The concept of relative prices and business equilibrium in general was perhaps of next importance. The particular cycle of an individual industry was another.

If the engineer were to retain and enhance his place in the procession of progress, said Mr. Jappe in closing, he would need to think along appropriate lines. An understanding of the business cycle was of the essence of this program. The ignorance of the many constituted the opportunity of the few.

L. W. WALLACE SPEAKS AT MANAGEMENT LUNCHEON

On Wednesday there were three luncheons, one sponsored by the Management Division, at which L. W. Wallace, chairman of the Committee on Research, spoke on "Currents of Influence." Harold B. Bergen, chairman of the Management Division, presided. This was the Management Division's Twentieth Anniversary Luncheon.

The 47 guests attending the luncheon were the past members of the executive committee since the Management Division's inception in 1920, the present executive committee, the general advisory committee, the division's local-section representatives, and invited guests of other management organizations.

Mr. Wallace said that although twenty years was an almost imperceptible dot upon the map of time, nevertheless, within such small time dots mighty currents of influence were frequently generated to flow on to the end of time. This fact should cause one to pause and think soberly, deeply, and broadly before releasing a current of influence. There should be every possible assurance that the current released carried only elements which would enrich the economic, intellectual, and moral fabrics of the human race. Never in history had there been graver need for currents of influence that would beget a larger measure of moral integrity, intellectual foresight, and honesty and adherence to fundamental spiritual precepts than there was in the hour in which he spoke.

Twenty years ago, said Mr. Wallace, the engineering profession in the United States had supplied the wellspring of three currents of influence. These were the American Engineering Council, the report on "Waste in Industry," and the formation of the Management Division of The American Society of Mechanical Engineers. These three currents of influence, he said, had carried a common theme—the benefit of man. It was quite evident, he thought, that the ideas and motives carried forward by the three currents of influence he had mentioned had been generally accepted, and that this acceptance meant that there had been a decided advance in the thinking and spirit of management. However, he warned, there were frontiers yet to be explored and, upon the basis of facts so obtained, cleared and made habitable in the interest of mankind and the preservation of civilization.

In order to obtain some intimation of the real character of these frontiers and how they might best be surveyed, a study had been made of the writings of an eminent Egyptologist, a profound anthropologist, and a learned theologian. These men had sounded the same keynote, it was found, the essence of which was that if the human race were to survive with any measurable degree of comfort, security, and enduring satisfaction, there would have to come into dynamic action a much larger measure of intelligent, enlightened, and humane leadership; a much higher degree of moral integrity; and a pronounced growth in the appreciation of and conformity to the things of the spirit. This same keynote, Mr. Wallace asserted, had been the generator of the currents of influence let loose by the engineering profession twenty years ago.

There appeared to Mr. Wallace to be little hope of obtaining that degree of humanity to man, required to safeguard and enrich all that man held dear and enobling, other than through raising the intelligence and understanding of the masses and obtaining a greater appreciation of, and adherence to, the eternal verities classified as things of the spirit. The accomplishment of these things was the serious task confronting management today. Into this area management would have to advance with all the intelligence, human sympathy, and understanding it could command. Otherwise, all might be lost. His conviction was so deep and compelling that he earnestly besought his hearers to keep flowing vigorously the currents of influence released by the engineering profession.

TEXTILE AND STUDENT LUNCHEONS

At the Textile Division luncheon, F. L. Bradley, presiding, R. H. DeMott, general sales manager of the SKF Industries, Inc., Philadelphia, Pa., read a paper entitled "Antifriction Bearings as Applied to Textile Machinery."

The third luncheon provided an opportunity for student and junior members to meet with members of the A.S.M.E. Council. Huber O. Croft, chairman of the Committee on Relations With Colleges, presided. There were brief talks by President McBryde and President-Elect Hanley, and the certificate of award of the Pi Tau Sigma Medal was presented to George A. Hawkins, associate professor of mechanical engineering, Purdue University. Professor Hawkins read a paper "High-Pressure, High-Temperature Steam Research at Purdue University," illustrated with lantern slides.

A. R. CULLIMORE SPEAKS ON CIVIC RESPONSIBILITIES

The Thursday luncheon was addressed by A. R. Cullimore, president, Newark College of Engineering, who spoke on civic responsibilities.

Mr. Cullimore said that duty had a place in our thinking and philosophy. There was, for example, the difficult problem of national defense, and many other problems that faced the young engineer, such as unionization and politics. It might be hard to fight, he asserted, but fighting at certain times was part of the game. War meant sacrifice and duty.

It was easy to say, he pointed out, that we could get cooperation if we had the power. But, after all, that was what we were fighting against—someone who had power to demand cooperation. Democracy had to be saved, he said, although the easiest course would be to let it fail.

Using a parable of a man who found himself in a boat with his wife who could not swim, Mr. Cullimore showed how democracy was today in danger of sinking if we were not to save her. To teach democracy how to swim was one of our first obligations. The A.S.M.E. Committee on Citizenship, of which he was chairman, had been trying to do this for seven years. We had learned, he said, that we could not get something for nothing; we could not take out of the political and social machine more than we put into it. We could not enter the political arena just before election and hope to win. After all, we reaped what we sowed. This was also true of the economic machine, for which the familiar energy equation still held. If we were to benefit from it, we must constantly put in more than we expected to take out. Young engineers, he said, saw the truth of these principles.

It was a fundamental fallacy, he continued, to believe that no one could do anything all by himself. If enough men were introduced into a situation, the cumulative effect would be to get something out. In an emergency, such as the present one, we were all in it.

No other government, he said in conclusion, had done as much for its citizens as had the government of the United States for us. It was time, he said, to pay back this debt.

PHOTOGRAPHIC EXHIBIT

In connection with the 1940 Annual Meeting the A.S.M.E. held its Fifth Photographic Exhibit. Photographs appropriately mounted were hung in a gallery on the eighth floor of the Astor, and a committee of judges awarded prizes for the best photographs in several classes. By special arrangement, opportunity was afforded the editors of MECHANICAL ENGINEERING to choose for publication such entries as best suited their needs. This issue contains many of these selections.

In addition to the photographs there was displayed a portion of a remarkable collection of photostats of prints and engravings from the collection of Sidney Withington, electrical engineer of the New York, New Haven, and Hartford Railway Company, New Haven, Conn., showing examples of self-propelled road vehicles of a century ago. The collection contained many cartoons as well as drawings and sketches, and was supplemented by a brief manuscript prepared by Mr. Withington to provide a background for the display.

Judges for the Photographic Exhibit were Howard Trafton, commercial artist, J. Chislain Lootens, teacher of photography, and Phil Andrews, former editor, *U. S. Camera*. There were three classes: *A* (members) divided into portraits, landscapes and marines, technical and industrial, architecture, and genre; *B* (nonmembers) divided into the same subjects as *A; C*, best in show. In class *A* (members) Walter L. Betts received first and W. M. Murray, second prize. In the subdivisions of class *A*, Francis P. McCormack was first for portraits, Frank E. Petura first for landscapes and marines; George G. Hyde first for technical and industrial; E. J. Flavin first for architecture; C. H. Durkee first for genre. In class *B* (nonmembers) C. T. Boyles received first and Howard Hamman, second prize. In the subdivisions of class *B*, John J. Mulhern was first for portraits; Nat Norman first for landscapes and marines; W. P. Brandegee first for technical and industrial; Fred J. Carisi first for architecture; and Frank Weinstabl first for genre. In class *C*, best in show, Monroe J. Gensler received first and E. K. Alenius, second prize.

COLLEGE REUNIONS

Alumni reunions of eleven engineering colleges were held in connection with the 1940 A.S.M.E. Annual Meeting.

The Brown Engineering Association met on Thursday evening for dinner at the Princeton-Brown Club; Dr. Henry Wriston, president of Brown University, was the speaker.

On Friday evening the New York Section of the Clarkson Alumni Association met for dinner in the clubrooms of the Building Trade Employers Association with John A. Ross, Jr., president, Clarkson College, as principal guest and speaker.

The Harvard Engineering Society met on Thursday evening at the Harvard Club for an informal dinner which was followed by a meeting.

The reunion dinner of the M.I.T. Alumni Association met at the Technology Club of New York with Prof. Jerome C. Hunsaker in attendance.

The Mechanical Engineering Alumni Dinner of New York University was held at the N.Y.U. Faculty Club on Thursday evening with Dean Collins P. Bliss and Prof. W. R. Bryans as guests of honor. Frederick K. Teichmann spoke on "Use of Modern Military Aircraft."

Doctor Doll, course superintendent of mechanical engineering at Pratt Institute, was speaker at the Pratt reunion dinner on Thursday evening at Childs Restaurant in West 42d Street, New York.

The Purdue Club of New York City held its Purdue-A.S.M.E. Presidents' Night dinner meeting on Thursday in the clubrooms of the Building Trades Employers Association. The speakers included Past-Presidents A. A. Potter and Wm. L. Batt, and President-Elect William A. Hanley.

Worcester Polytechnic Institute held its reunion dinner on Thursday evening at the Machinery Club, where Admiral Wat Tyler Cluverius, President, W.P.I., and Dr. A. J. Schwerger, head of the department of economics, government, and business, were speakers.

Rensselaer Polytechnic Institute, Tufts College, and Stevens Institute of Technology also held reunion dinners.

TECHNICAL PROGRAM VARIED AND EXTENSIVE

No attempt can be made in this brief report of the 1940 Annual Meeting to do justice to the extensive and varied program of technical papers—more than one hundred in number—that were presented at the 44 technical sessions. For months prior to the meeting, strenuous efforts were made to round up manuscripts of the papers presented, subject them to the customary procedure of review by experts of the sponsoring groups, and put them in shape for publication. As it turned out, 46 of the papers were available in preprint form from the Transactions and the *Journal of Applied Mechanics*, 15 were reprinted or preprinted from MECHANICAL ENGINEERING, and 20 were in mimeograph form. In other words, slightly less than 80 per cent of the technical papers offered for discussion were available in some preprint form.

Practically every professional division and several technical committees sponsored sessions. The Aeronautics Division held one session devoted to machine line production of aircraft materials and its annual report of progress in the field of aeronautics. The Applied Mechanics Division held six sessions, one of which was sponsored jointly by the Power Division, and in another the Oil and Gas Power Division cooperated. The Fuels Divisions conducted two sessions and a third in cooperation with the Power Division. The Management Division held three joint sessions, one with the Power Division and two with the Committee on Education and Training for the Industries. It also put on three sessions under the auspices of its Work Standardization, Industrial Marketing, and Mathematical Statistics Committees, and held a Twentieth Anniversary luncheon as well.

The Heat Transfer Group, the Hydraulic Division, and the Railroad Division held two sessions each, and the Textile Division sponsored a luncheon in addition to its two technical sessions. All except one of the sessions of the Power Division were jointly sponsored by other groups; the Metals Engineering Division held one session, and the Machine Shop Practice Division two. The single session of the Petroleum Division was held jointly with the Committee on Industrial Instruments and Regulators of the Process Industries Division. The Process Industries Division itself held five sessions, one of which was with the cooperation of the Standing Committee on Safety, and two of which were sponsored by the division's Committee on Rubber and Plastics. Its Committee on Industrial Instruments and Regulators, in addition to the session held jointly with the Petroleum Division, held another under its own auspices. The Materials Handling Division held two sessions, in one of which the American Society of Naval Architects and Marine Engineers cooperated. This society also jointly sponsored a symposium on power in ships with the Power Division.

Of the Technical Committees, the Joint Research Technical Committee on the Effect of Temperature on the Properties of Metals held two sessions, one jointly with the Power Division; the Joint Research Committee on Boiler Feedwater Studies two, one jointly with the Power Division; the Research Technical Committee on Lubrication held two sessions, and the Research

"SPRING PLANTING"

(Photograph taken by W. L. Betts and shown at the Fifth Annual Photographic Exhibit held during the A.S.M.E. Annual Meeting, Dec. 2-6, 1940, New York, N. Y.)

Technical Committee on Mechanical Springs and the Research Technical Committee on Fluid Meters, one each.

TECHNICAL COMMITTEE MEETINGS

As usual, coincident with the technical sessions were held a group of thirty-one technical-committee meetings. This group of meetings began on Sunday afternoon with the meeting of the Research Committee and continued until Friday morning. They were divided among the general subdivisions as follows: Research, 10; Standards, 14; and Power Test Codes, 7.

THE RESEARCH GROUP

The annual meeting of the A.S.M.E. Research Committee was held in the Hotel Astor on Sunday afternoon. Those present were Chairman L. W. Wallace, E. G. Bailey, M. D. Hersey, Albert Kingsbury, R. J. S. Pigott, A. E. White, G. A. Hawkins, and R. W. Morton. This was an executive session, no general research dinner meeting being scheduled this year.

The committee waded through long agenda of routine business which included formal approval of actions taken by correspondence during the year and reports received. Of special interest is the nomination of Warren R. Elsey, mechanical engineer of the Pennsylvania Railroad for appointment to the committee for the five-year term beginning December, 1940. E. G. Bailey, who is serving his fifth year on the committee, was elected chairman for the coming year in the place made vacant by the retirement of L. W. Wallace.

During the year the committee had developed a report on its functions and procedures with special reference to the relation of its work to that of the A.S.M.E. professional divisions. The chairman reported that this series of recommendations had been accepted and approved by the A.S.M.E. Council in June, 1940.

Ten special and joint research-committee meetings were held during the five days of Annual Meeting week. They were all well attended, and in each case good progress was recorded.

The Special Research Committee on Condenser Tubes led off with its annual meeting and conference on Tuesday. It began with luncheon and continued until late in the afternoon. Chairman A. E. White presided and fifty persons were present.

At the same time the Special Research Committee on the Rolling of Steel, A. Nádai, chairman, held its usual luncheon meeting. On Wednesday morning, December 4, at the session on rolling and plasticity, Dr. A. Nádai and M. J. Manjoine presented the final report of their project entitled, "High-Speed Tension Tests at Elevated Temperatures, Part II." Part I was presented before the A.S.T.M. in June, 1940.

The Joint Research Committee on Boiler Feedwater Studies, C. H. Fellows, chairman, sponsored two technical sessions. The first was held on Monday evening. Chairman Fellows presided and the following three papers were presented: "Silica in High-Pressure-Boiler Waters," by Harold Farmer; "Silica Removal by an Improved Magnesia Process," by H. L. Tiger; and "Adsorption Process for Removal of Soluble Silica From Water," by L. D. Betz, C. A. Noll, and J. J. Maguire.

This committee joined with the A.S.M.E. Power Division in sponsoring its second technical session held on Thursday morning. The two papers presented at that session were: "Treatment of Make-Up Water for the Waterside Topping Installation," by C. B. Arnold, R. T. Hanlon, and Julius Mindheim; and "A New Degasifying Steam Condenser for Use in Conductivity Determinations," by F. G. Straub and E. E. Nelson. W. E. Caldwell presided at this session.

The meeting of the executive committee of this joint research committee was held on Wednesday afternoon. The Subcommittee on Effect of Solution Composition on the Cracking of Boiler Metals, J. H. Walker, chairman, met on Tuesday afternoon and discussed certain details of its research program.

On Wednesday morning the Special Research Committee on Fluid Meters, R. J. S. Pigott, chairman, held its annual business meeting at which the principal topic of discussion was the financing of its new research project on volumeters. This discussion was based on the report of the chairman of its subcommittee on fund raising, E. C. M. Stahl.

H. S. Bean made a progress report covering the research on flow nozzles which was to the effect that this study is nearing completion.

This special committee sponsored a technical session on Wednesday afternoon. Chairman R. J. S. Pigott was in the chair and the following four papers were read and discussed: "The Annis Meter," by M. B. MacNeille and R. K. Annis; "Effect of Ambient Temperatures on the Coefficients of Venturi Meters," by W. S. Pardoe; "Discharge Coefficients of Long-Radius Nozzles When Used With Pipe-Wall Pressure Taps," by H. S. Bean, S. R. Beitler, and R. E. Sprenkle; and "Progress in Volumeter Research," by E. E. Ambrosius.

The Special Research Committee on Lubrication also sponsored two technical sessions. These were held on the morning and afternoon of Wednesday. M. D. Hersey presided at the first and G. B. Karelitz at the second. The five papers at these two sessions were: "Relationship of Viscosity to Rate of Shear," by L. J. Bradford and F. J. Villforth; "The Flexible-Sleeve Multiple Oil-Film Radial Bearing," by Gustave Fast; "Flow Properties of Lubricants Under High Pressure," by A. E. Norton, M. J. Knott, and J. R. Muenger; "Power Losses in High-Speed Journal Bearings," by F. C. Linn and D. E. Irons; and "Friction Torque in Ball and Roller Bearings," by Haakon Styri.

The Special Research Committee on the Cutting of Metals, M. F. Judkins, chairman, and the Subcommittee on Cutting Fluids, O. W. Boston, chairman, held their customary annual luncheon meeting. The following activities during the year were reported: (1) The preparation of a questionnaire to be sent to the metal-cutting trade to determine the extent and method of use of the various cutting materials; (2) the preparation of a cutting-material atlas in which an endeavor will be made to list trade names, typical composition, and recommended use of virtually all commercially available cutting-tool materials; (3) the preparation of a metal-cutting bibliography. The chairman of one of the subcommittees is endeavoring to secure funds with which to finance another research project of surface quality at low speeds with special reference to tapping.

At the Machine Shop Practice session on Tuesday morning, December 3, the report of the Subcommittee on Cutting Fluids was presented. Its title is "Surface Quality of an S.A.E. 3140 Steel" and is a study based on various combinations of speeds, structures, and cutting fluids and was written by O. W. Boston and W. W. Gilbert.

Chairman J. R. Townsend presided at the business meeting of the Special Research Committee on Mechanical Springs which was held on Wednesday afternoon. In the absence of an immediate experimental program, the committee is carrying on certain theoretical researches in an endeavor to solve a number of problems in spring design.

That morning the special research committee sponsored a technical session at which the following papers were presented: "Recommended Code of Procedure for Fatigue Testing of Hot-Wound Helical Compression Springs," by C. T. Edgerton, and "Effect of Temperature on Coiled Steel Springs Under Various Loadings," by F. P. Zimmerli.

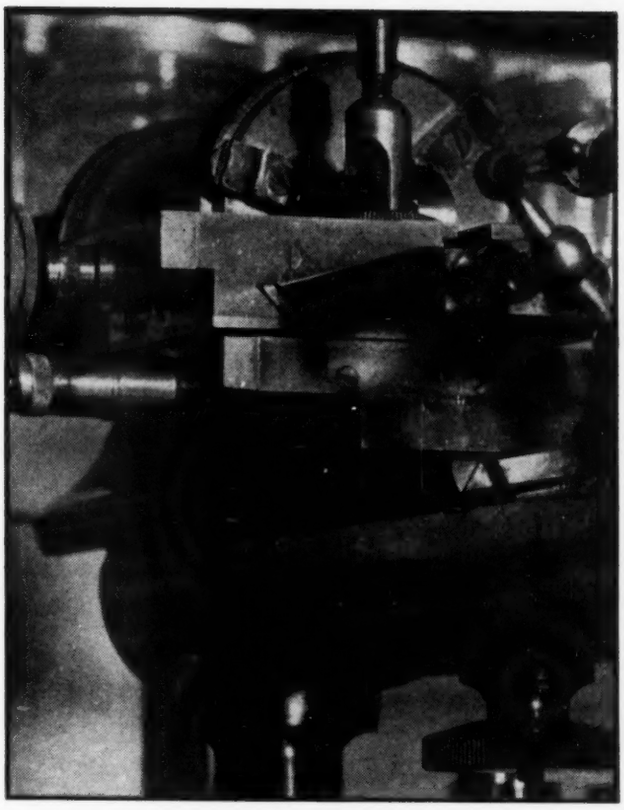
The Special Research Committee on Critical Pressure Steam Boilers, H. L. Solberg, chairman, met on Wednesday afternoon. It was reported that the following work was completed during the year: (1) The viscosity of steam at pressures up to 1800 psi abs and 1000 F; (2) the effect of time upon the corrosion of ten different steels in contact with steam at a uniform temperature of 1100 F has been determined for periods of exposure of 200, 500, 1000, and 2000 hours; (3) a series of 500-hr tests under steady temperatures between 1000 and 1200 F. There has been undertaken an investigation of the effect of stress upon the oxidation of various alloy steels by high-temperature steam.

A technical session was sponsored also by the Joint Research Committee on Effect of Temperature on the Properties of Metals, N. L. Mochel, chairman. This session was held on Thursday afternoon. The following papers were presented: "A High-Temperature Bolting Material," by A. W. Wheeler; "Effect of Grain Size and Structure on Carbon-Molybdenum Steel Pipe," by A. E. White and Sabin Crocker; and Progress Report on Creep of Tubular Specimens, Project No. 10: (1) "Tubular Creep Tests," by F. H. Norton; and (2) "Interpretation of Creep Tests on Tubes," by C. Richard Soderberg.

THE STANDARDS GROUP

This year the A.S.M.E. Standardization Committee opened its group of meetings with its annual meeting on Monday morning, Dec. 2. Chairman W. C. Mueller presided and A. L. Baker, J. E. Lovely, and T. E. French were present. This was the entire membership since J. R. Weaver had resigned in November. In addition to these four active members the committee was pleased to welcome two of its advisory members, C. P. Bliss and A. M. Houser.

This was strictly a business session and among the items reported by Secretary C. B. LePage was the fact that the committees for which the A.S.M.E. is sponsor or joint sponsor had completed ten standards since the last annual meeting of the committee. In the order of their completion these are: (1) Backlash for General-Purpose Spur Gearing, B6; Twist Drills, B5; Surface Roughness, B46; Keyways for Holes in Gears, B6; 250-Lb Cast-Iron Flanges and Flanged Fittings, B16; Addendum to Steel Pipe Flanges and Fittings, B16e–1939; Steel Butt-Welding Fittings, B16; Wrench-Head Bolts and Nuts and Wrench Openings (Revision), B18; Soldered-Joint Fittings, A40; Abbreviations for Scientific and Engineering Terms (Revision), Z10.



"STUDY IN PRECISION"

(Photograph taken by George G. Hyde and shown at the Fifth Annual Photographic Exhibit held during the A.S.M.E. Annual meeting, Dec. 2–6, 1940, New York, N. Y.)

The progress made by the many other standards committees for which the Society is sponsor or joint sponsor is recorded in the standing committee's annual report which is published as part of a separate pamphlet available on application.

PERSONNEL CHANGES

The following changes in the personnel of the committee were approved and recorded. William H. Hill, president, Baldwin-Hill Company, Trenton, N. J., was nominated for appointment as the new member of the committee; A. L. Baker was unanimously elected chairman for the coming year; and W. C. Mueller retired from active membership on the committee with the hearty thanks and felicitations of its members. He was added to the list of the committee's advisers.

Alfred Iddles was nominated for reappointment by the President as one of the two A.S.M.E. representatives on the A.S.A. Standards Council for a three-year term and W. C. Mueller and C. B. LePage were nominated for appointment by President Hanley as alternates to Messrs. Baker and Iddles.

SURFACE QUALITIES

On Monday afternoon two committees held important meetings. The meeting of Sectional Committee on Classification

and Designation of Surface Qualities, B46 was presided over by Secretary H. J. Wills and the meeting of Technical Committee No. 9 on Punch Press Tools, B5 was led by W. C. Mueller. Committee B46 reviewed in a general way the comments which it has received as a result of the distribution of its first proposed standard entitled "Surface Roughness." Committee No. 9 of B5 elected T. W. Ragan as its permanent chairman and discussed in detail the form which its final report should take. Since its appointment in September, 1928, this committee has developed a number of proposals but none of them has been entirely satisfactory.

STRAIGHT-BLADE CUTOFF TOOLS

On Tuesday morning Technical Committee No. 10 of B5 met with W. C. Mueller, chairman, to examine a draft of a proposed American Standard for Straight-Blade Cutoff Tools.

CAP AND SETSCREWS

Subcommittee No. 9 of Sectional Committee B18 met on Tuesday morning. This subcommittee has as its special duty the standardization of socket-head cap and setscrews. The present American standard was completed and approved in February, 1936. At this meeting the subcommittee reviewed the comments it had received during the last four years.

DRAWINGS AND DRAFTING-ROOM PRACTICE

Tuesday afternoon saw the revival of project Z14 on the standardization of Drawings and Drafting-Room Practice of which Dean F. DeR. Furman has been chairman. Dean Furman presided at the meeting and Prof. F. G. Higbee served as secretary pro tem. Prof. T. E. French who had been chairman of the Editing Committee of the present American Standard, Z14.1–1935 opened the discussion and read a list of corrections and additions which in his opinion should be considered at this time. Prof. F. W. Ming also submitted in writing what he proposed as further changes and additions.

Prior to the meeting Chairman Furman had expressed his desire to be relieved of the duties of the chairmanship. The members of the committee were sorry to have him retire and consented only on his insistence. They then unanimously elected Prof. T. E. French as his successor. Chairman French was then authorized to appoint a subcommittee to undertake the drafting of the revision of the present standard.

CODE FOR PRESSURE PIPING

As a preparation for the annual meeting of the Sectional Committee on a Code for Pressure Piping, B31, E. B. Ricketts, chairman, its Subcommittee No. 1 on Plan, Scope and Editing, Sabin Crocker, chairman, held a meeting on Tuesday afternoon. The personnel of this subcommittee consists of the officers of the sectional committee and the chairmen of the several subcommittees. Certain questions affecting the unity of the several sections of the present revision of the Code for Pressure Piping were discussed and the committee's editorial policy was reaffirmed. Approved drafts of all of the six sections of the code were before the committee at this meeting.

On Thursday morning this editing committee reported to Sectional Committee B31 at a largely attended meeting over which Chairman Ricketts presided. Fifty persons were present. The principal action taken by the committee was to grant to certain groups the eight weeks period to February 1 for the adjustment of a number of slight differences. After that date the code will be put in type and sent to the members of the sectional committee for vote on approval by letter ballot.

SCREW THREADS

The meeting on Tuesday morning of the Special Subcommittee on Revision of the American Standard for Screw Threads of Committee B1 was presided over by its chairman, P. V. Miller. The A.S.M.E. office had prepared and distributed copies of a summary of the replies received to the questionnaire formulated and distributed in February, 1940. A general review of this summary formed the first item of business. A second item was the amount and position of the proposed standard allowance for plating screws, bolts, and nuts. Early in the meeting the subcommittee passed a resolution to the effect that, while it proposed to continue its work leading to the improvement of the American Standard for Screw Threads recorded in A.S.A. B1.1–1935, it did not propose to revise this standard during the present national emergency.

A second important screw-thread meeting was held on Tuesday afternoon, that of Subcommittee No. 5 on Screw Thread Gages and Inspection of Sectional Committee B1, over which George S. Case presided. This meeting also was well attended and the principal item of business was a detailed review of the final report of its Subgroup on Screw-Thread Gaging Practice, H. B. Hambleton, chairman. Printer's proof copies of this proposed American Standard for "Screw-Thread Gages and Gaging" had been distributed to the members of the subcommittee prior to the meeting by the A.S.M.E. office. At the close of the meeting the subcommittee voted to present this proposed standard with corrections and additions to the members of Sectional Committee B1 for vote on approval by letter ballot.

Forty-five persons attended the meeting of the Sectional Committee on the Standardization and Unification of Screw Threads, B1, R. E. Flanders, chairman, on Wednesday morning. In the absence of the chairman, A. M. Houser vice-chairman presided and Earle Buckingham secretary reported the meeting.

Subcommittee No. 4 on Acme Screw Threads was the first to be called to report. Printer's proof copies of this proposal in its present revised form were available to those present at this meeting but Chairman Buckingham explained that the present draft was not, as yet, released to the sectional committee by Subcommittee No. 4. He expressed the belief that this step would be taken after the next meeting of the subcommittee.

The report of Subcommittee No. 5 on Screw Thread Gages and Inspection was next presented by its chairman, Geo. S. Case. This subcommittee had held a meeting the previous day at which thirty-five were present and had reviewed the printer's proof draft of its proposed American Standard for Screw-Thread Gages and Gaging, dated November, 1940. Copies of this draft had been mailed to the members of the subcommittee and the sectional committee the previous week. At the close of his report, Chairman Case moved that the proposal of his committee in its finally revised form be sent to letter-ballot vote of the members of Sectional Committee B1. This motion was passed without a dissenting vote.

Chairman P. V. Miller then reported for his Special Subcommittee on Revision and Extension of the Present American Standard. He explained that the meeting of his subcommittee held the previous day had been well attended and that certain general decisions had been reached as to the parts of the present American Standard that should be studied in preparation for changes at the right time. Copies of a summary of the replies to the subcommittee's questionnaire of February, 1940, had been mailed to the members of the sectional committee in advance of the meeting.

The last report to be presented was that of Prof. E. Buckingham who in cooperation with P. V. Miller's subcommittee is investigating experimentally the factors which affect the strength of screw threads. Some time ago the manufacturers of bolts and nuts supplied him with samples of their product in

various forms and it is this material that he has used in the experiments, the results of which he reported to the committee.

SMALL TOOLS

On Wednesday morning also Prof. O. W. Boston's two technical committees in the B5 group held meetings in advance of the sectional committee meeting scheduled for that afternoon. They were Technical Committee No. 2 on Tool Posts and Tool Shanks and Technical Committee No. 21 on Tool-Life Tests for Single-Point Tools. Both subcommittees reported progress at the sectional committee meeting, the first on the revision of the present American Standard B5.b–1929 and the second toward the organization of this new project.

Routine reports from the various technical committees which are active at present characterized the program of the annual business meeting of the Sectional Committee on the Standardization of Small Tools and Machine Tool Elements, B5, W. C. Mueller, chairman. Good progress was reported all along the line and notice was given of the final approval of the American Standard for Twist Drills by the American Standards Association since the last meeting of the committee.

The new secretary of the sectional committee, P. L. Houser, was present and reported the meeting with the assistance of T. W. Ragan.

LOCK WASHERS

An important event was scheduled for Thursday morning, the last day of Annual Meeting week. This was the reorganization of Subcommittee No. 2 on the Standardization of Lock Washers. This is a subdivision of Sectional Committee B27, W. L. Barth, chairman. Thirteen attended the meeting, and as the first order of business received with regret the resignation of A. W. Mellowes as chairman. With Mr. Barth in the chair, E. D. Cowlin was elected as the new chairman. He in turn named the following subgroup to prepare the first draft of a proposed American Standard for Spring Washers: Messrs. C. C. Washer, chairman, G. A. Aiken, P. L. Houser, H. A. Marchant, and Erling Wessel.

COMMITTEES MAKE IT GO

Conduct of the Annual Meeting of the A.S.M.E. is a responsibility of the Committee on Meetings and Program, but the innumerable details of technical and social gatherings and the planning of hundreds of events call for cooperation of practically every other standing committee and for the active support of many special committees. Heading the Committee on Meetings and Program for 1940 was Erik Oberg, and supporting him were W. J. Wohlenberg, A. L. Kimball, N. E. Funk, and L. K. Sillcox.

The Special Committees set up for the conduct of the 1940 Annual Meeting were as follows:

RECEPTION COMMITTEE: A. R. Mumford, *chairman*, T. B. Allardice, G. A. Anbro, W. L. Betts, E. J. Billings, W. G. Blake, W. F. Carhart, H. C. R. Carlson, F. D. Carvin, E. V. David, M. W. Deutschman, J. M. Driscoll, A. Ehbrecht, A. F. Ernst, E. H. Fezandie, Crosby Field, P. E. Frank, W. S. Gleeson, G. E. Hagemann, W. J. Hargest, C. A. Hescheles, H. R. Kessler, W. H. Larkin, 3d, W. W. Lawrence, W. McC. McKee, L. H. Morrison, G. J. Nicastro, A. L. Nicolai, W. S. Patterson, C. B. Peck, William Raisch, M. J. Reed, Hermann Reese, H. F. Ritterbusch, O. B. Schier, 2d, M. S. Symon.

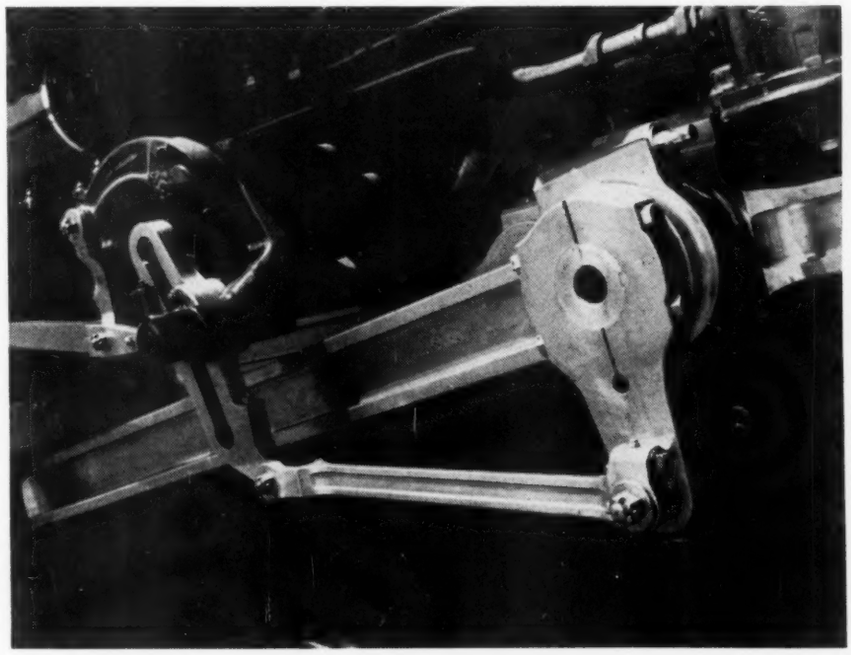
DINNER AND HONORS NIGHT. Francis Hodgkinson, *chairman*, E. J. Billings, *vice-chairman*, W. McC. McKee, H. A. Cox, S. H. Libby, C. E. Gus, C. F. Kayan, Mrs. C. F. Kayan, Mrs. E. C. M. Stahl.

PHOTOGRAPHIC GROUP: G. G. Hyde, *chairman*, W. L. Betts, J. F. Guinan, C. G. Humphreys, R. C. Petura.

PLANT TRIPS: W. G. Blake, *chairman*, E. E. Jackson, E. J. Lassen.

SMOKER: O. B. Schier, 2d, *chairman*, W. J. Angus, E. J. Billings, A. E. Blirer, G. J. Nicastro, C. A. Hescheles, L. F. Zsuffa.

WOMEN'S EVENTS: Mrs. Collins P. Bliss, *general chairman*, Mrs. Arthur C. Coonradt, *vice-chairman*, Mrs. C. Higbie Young, Mrs. Randall B. Purdy, Mrs. Clifford B. LePage, Mrs. G. Laurence Knight, Mrs. Crosby Field, Mrs. Charles E. Gus, Mrs. Earl B. Smith, Miss Burtie Haar.



STAINLESS STEEL

(Photograph taken by E. K. Alenius and shown at the Fifth Annual Photographic Exhibit held during the A.S.M.E. Annual Meeting, Dec. 2–6, 1940, New York, N. Y.)

A.S.M.E. NEWS

And Notes on Other Engineering Activities

Metropolitan Section Is Host at Smoker During Annual Meeting

More Than 500 Members and Guests Enjoy Circus With Clowns, Red-Coated Band, and Superb Acts

FOR more than four hours on the evening of Dec. 3, 500 members and guests of The American Society of Mechanical Engineers ate, drank, and made merry under a big circus tent erected in the grand ballroom of the Hotel Astor. The occasion, a part of the program for the 1940 Annual Meeting of the Society, was the "Stag Circus and Smoker," arranged and staged by O. B. Schier, 2nd, chairman, and a special committee of the Metropolitan Section.

As the members and guests entered the hotel lobby leading to the ballroom, they saw circus wagons, stuffed wild animals, gamboling clowns, and sideshow posters on the walls. Pink lemonade was available for the asking and many an engineer was able to satisfy a boyhood ambition to drink as much of it as he could, especially since it was free. Both singers and nonsingers joined in with a group of musical clowns to sing "Sweet Adeline," "How Dry I Am," and others.

About this time, the big parade, led by a red-coated brass band playing "Roll Out the Barrel," formed and rolled into the big tent. It wasn't very long before each circus fan had found a seat at one of the many checker-cloth-covered tables. Waiters and waitresses brought in the food which consisted of delicious soup, hot dogs, roast beef, boiled ham, turkey, vegetables, rolls, pie, coffee, and beer. Several of the boys had second helpings. While the eating was in progress, the brass band played popular numbers. During the band intermissions, the musical clowns serenaded the various tables with songs.

Professional Entertainment

After the last dish had been cleared away, William J. (Bill) Angus, member A.S.M.E., started the evening's main entertainment with a series of humorous stories. When the laughter had died down, he introduced Jolly Bill, the professional master of ceremonies, who introduced a few of the prominent members and revealed some intimate details of their private lives. Jolly Bill then asked the band to play the opening musical number of a roller-skating act performed by a young couple on a wooden mat 6-ft square. The members were so interested in the way the two skated that two prominent members accepted the couple's invitation to take a ride with them. It took a little time for each member to recover himself after being twirled around at 100 rpm.

For the next fifteen minutes, a deep-voiced blonde songster entertained with a group of popular songs. She was followed by a magician who changed celluloid eggs into real eggs, transferred objects from his person to that of a member without anyone in the audience being able to discern how it was done, pulled out a glass of water from a black bag, and performed other feats of legerdemain. The evening was concluded with all members of the audience singing "Auld Lang Syne."

Committee Members

Besides O. B. Schier, 2nd, and William J. Angus, other members of the committee for the smoker were Edward J. Billings, Arthur E. Blirer, George J. Nicastro, Charles A. Hescheles, and Leslie F. Zsuffa.

PRESIDENT MCBRYDE, SECRETARY DAVIES, AND PRESIDENT-ELECT HANLEY AT THE ANNUAL MEETING

Student Members and Juniors Have Day at 61st Annual Meeting of the A.S.M.E.

Special Luncheon, Plant Trips, Technical Sessions, and Annual Banquet Attended by Engineering Youth

WEDNESDAY, Dec. 4, the third day of the five-day Sixty-First Annual Meeting of The American Society of Mechanical Engineers held in New York City during the week of Dec. 2, was dedicated by the Meetings and Program Committee to the engineering youth of the Society, namely, the 6000 student members and the 3500 juniors throughout the United States and Canada. Visits for the students were held in the morning and afternoon to the R. H. Macy Company store and power plant, and in the afternoon to the printing establishment of the *New York Herald Tribune*. The big event of the day was the Student-Junior-Council Luncheon in the Rose Room of the Hotel Astor. In the evening, the official representatives of each Student Branch were guests of the Old Guard at the Annual Banquet. More than 300 student members and the same number of juniors took part in one or more of the aforementioned functions. Many also attended the regular technical sessions, visited Power Show, and enjoyed the Annual Tea given by the Woman's Auxiliary of the A.S.M.E.

Plant Trips

The trip to the R. H. Macy Company department store, the largest of its kind in the world, proved very interesting to the budding engineers, since it gave them an insight into the many engineering and power problems encountered daily in this type of business. Of particular interest was the gigantic air-conditioning unit of the store. At the plant of the *New York Herald Tribune*, the boys learned how one of the foremost newspapers in the world is edited and printed. Many were surprised to see some sections, including the funny paper, for the following Sunday's edition rolling off the presses. Several juniors, members, and fellows also participated in some of the plant trips.

Student-Junior-Council Luncheon

With Prof. Huber O. Croft, chairman of the Committee on Relations With Colleges, presiding, the Student-Junior-Council Luncheon took place in the Rose Room of the Hotel Astor with more than 200 participating. As a matter of fact, there were so many present that 30 or 40 of the boys were seated at tables in

A.S.M.E. PRESIDENTS—KIMBALL, CHRISTIE, MCBRYDE, AND MAIN.

DEAN DUDLEY OF YALE TALKS WITH A GROUP AT THE SMOKER

SECRETARY DAVIES GREETS PAST-PRESIDENT LAUER. L. AUSTIN WRIGHT, SECRETARY, E.I.C., AT EXTREME RIGHT

JOHN HAYDOCK, PRESIDENT MCBRYDE, AND GEORGE A. STETSON, EDITOR OF THE SOCIETY PUBLICATIONS

ALFRED IDDLES, A. D. BAILEY, R. M. GATES, AND N. E. FUNK

WILLIAM H. BOEHM, CHARLES T. MAIN, DEXTER S. KIMBALL

WARNER SEELEY, ERIK OBERG, AND SOL EINSTEIN

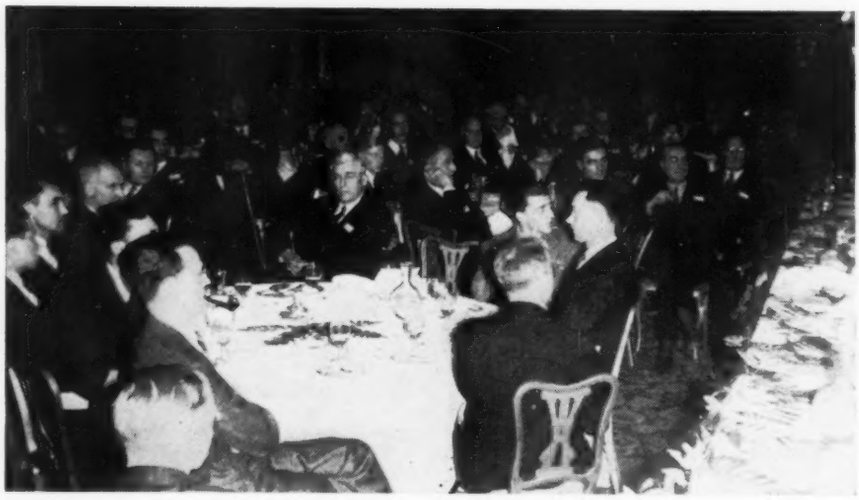
"THE COMMUTERS" QUARTET

At the Annual Meeting Smoker

the alcove off the main room. After a sumptuous feast, or "feed" as one student member called it, of soup, chicken, vegetables, ice cream, cake, and coffee, and a spirited discussion with the distinguished members seated at each of the tables, the boys settled back in their chairs when Professor Croft called the audience to order.

First of all, he introduced Warren H. McBryde, President of the A.S.M.E., who received a big hand from the boys, many of whom had met him previously on one of his many trips through the country. President McBryde thanked everyone for the wonderful cooperation accorded to him during the year and concluded by asking all "to carry on as always." The next one introduced, William A. Hanley, President-Elect of the Society, was an old friend of the boys since he had served as a member and as chairman of the Committee on Relations With Colleges. Mr. Hanley stated that he was surprised to see so many baldheads among the audience and hoped that the youngsters had learned something from the older men. He, personally, found young men more interesting because they didn't know all the answers and therefore were receptive to new ideas. In concluding his brief talk, the president-elect wished the student members and juniors success in their chosen careers, warned them of the hard work to be encountered, and told them that the future of the profession and the world depended upon their work.

Following these two brief talks, Professor Croft introduced the rest of those seated at the head table. These included C. E. Davies, secretary of the Society; Edward D. Rowan, Oregon State College, winner of the Undergraduate Student Award; Charles T. Main, past-president of the A.S.M.E., and donor of the award named after him; Frank De Pould, Case School of Applied Science, winner of the 1940 Charles T. Main Award of $150; Prof. Howard E. Degler, secretary of Pi Tau Sigma; George A. Hawkins, Purdue University, winner of the Pi Tau Sigma Medal; Robert E. Newton, Washington University, winner of the Junior Award; Prof. Paul B. Eaton, Lafayette College; George W. Shepherd, Princeton University, winner of the Postgraduate Student Award; Harte Cooke, chairman of the Old Guard; Edward B. Abril, from Argentine, graduate student at M.I.T. and winner of the 1940 Calvin W. Rice Scholarship awarded by the Woman's Auxiliary to the A.S.M.E.; and L. Austin Wright, secretary of the Engineering Institute of Canada.



LISTENING TO TALKS AT THE STUDENT LUNCHEON

G. A. Hawkins Explains Work

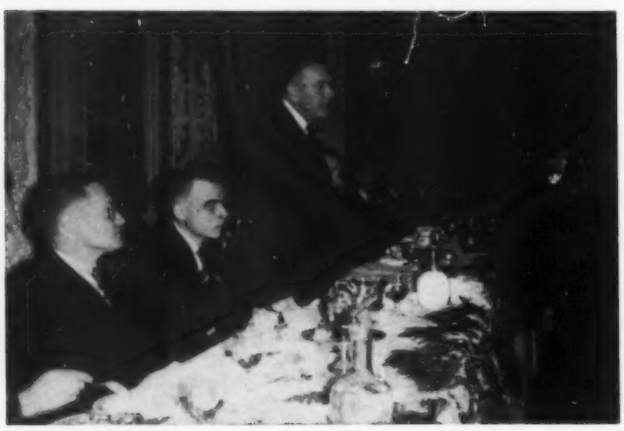
After Professor Degler had introduced him as the "outstanding young mechanical engineer of 1940," George A. Hawkins, who is an associate professor at Purdue University, gave a talk, illustrated with lantern slides, on his work as outlined in papers published in A.S.M.E. Transactions. One student member remarked after the talk that even though it was technical it showed the romantic and adventurous side of mechanical engineering. Even though the talk concluded the luncheon, many of the students remained for almost an hour talking with the older engineers.

Annual Banquet

In the evening, many of the student members were present at the Annual Banquet as guests of the Old Guard, a group of members who have been affiliated with the Society for 35 years or more and are thereby exempt from the payment of further dues but insist on contributing to a fund from which the tickets for branch representatives, the traveling expenses of award winners, and the Old Guard prizes at the ten regional Student Conferences are paid. This year there were quite a number of juniors and student members present at the reception and dance which followed the banquet because of the special rate established for them of $2 per couple.

R. E. Flanders Heads New England Council

RALPH E. FLANDERS, past-president A.S.M.E. and president, Jones & Lamson Machine Co., Springfield, Vt., was eleected president of the New England Council in Boston, Mass., Nov. 14, 1940, at the Sixteenth New England Conference, a two-day session jointly sponsored by the governors of the six New England states, and by the council, an organization of civic leaders, economists, industrialists, and manufacturers. In his address Mr. Flanders said that the unemployed must be brought into the defense program instead of shifting the work of those now employed and that the nation must get its defense material by expansion rather than by substitution.



PRESIDENT MCBRYDE ADDRESSES THE STUDENTS AT THEIR LUNCHEON WHILE FURTHER ALONG AT THE TABLE EDUARDO R. ABRIL, A.S.M.E. WOMAN'S AUXILIARY SCHOLARSHIP WINNER, IS FLANKED BY HARTE COOKE (LEFT) AND L. AUSTIN WRIGHT (RIGHT)

Actions of A.S.M.E. Executive Committee

Covering Meetings of Nov. 8 and Dec. 6, 1940

THE Executive Committee of the Council of The American Society of Mechanical Engineers met at the Society headquarters on Nov. 8, 1940, with Warren H. McBryde, president, in the chair. In addition to Mr. McBryde there were present James W. Parker, vice-chairman; Kenneth H. Condit, Clarke Freeman, and W. H. Winterrowd, of the committee; J. N. Landis (Local Sections), Harte Cooke (Professional Divisions), and J. J. Swan (Finance), advisory members; W. A. Hanley, president-elect; and C. E. Davies, secretary. The following actions of general interest were taken.

American Engineering Council

During the summer the American Society of Civil Engineers and the American Institute of Electrical Engineers gave notice of their intention of withdrawing from the American Engineering Council as of Dec. 31, 1940. It has thus become evident that, under the present circumstances, nothing would be gained by continuing the Council, and the Executive Committee therefore authorized certain changes in the budget and directed its representatives to urge an early meeting of the Council to close up its affairs. It also voted to authorize the president and the secretary to consult with representatives of other societies on the problems related to the Council and the establishment of a new organization to replace it.

N.C.S.B.E.E. Invited to Meet in New York

Confirmation was voted of a letter-ballot approval of extending an invitation to the National Council of State Boards of Engineering Examiners to hold its 1941 Convention in New York. (This invitation was accepted by the N.C.S.B.E.E. at its meeting on October 28–31 at Charleston, S. C.; and October 27–30, 1941, was tentatively set as the date of the 1941 convention.)

Personnel Service

The Secretary reported that in accord with authorization of the A.S.M.E. and the other Founder Societies, the Engineering Societies Personnel Service, Inc., had incorporated legally in the State of New York on May 24, 1940. Funds in the hands of the Engineering Societies Employment Service had been turned over to the new corporation. A branch of the new corporation has been instituted in Detroit, and is being supported through the preliminary stages by the corporation and the Engineering Society of Detroit. He also reported that the organization of the New York office under the new corporation had been completed and a new arrangement made with the Engineers Club of San Francisco.

Student Branch at I.I.T.

Because of the merger of the Armour Institute of Technology and Lewis Institute, both of Chicago, Ill., into the Illinois Institute of Technology, upon recommendation of the Committee on Relations With Colleges, it was voted to disband the A.S.M.E. student branches at the two formerly independent institutions and to authorize establishment of a student branch at the Illinois Institute of Technology.

Conference for Protection of Foreign Born

The Executive Committee noted with interest the communication from Prof. Walter Rautenstrauch, who was appointed to represent this Society at the Conference for the Protection of the Foreign Born, held in New York City on October 19, reporting on his attendance on that occasion. He stated that there was considerable evidence presented at the conference which indicated that the social disturbances under discussion were but the surface manifestations of deep-seated economic and social maladjustments in our society and it was his opinion that this Society should recognize these basic and fundamental problems and encourage discussions of them.

Standards and Codes

Approval was recorded, as standard practice of the Society, of the following standards: "Cast-Iron Screwed Fittings, 125 and 250 Lb;" "Welded and Seamless Steel Pipe;" and "Lap-Welded and Seamless Steel Pipe for High-Temperature Service;" also "Information on Instruments and Apparatus, Part 3, Temperature Measurements, Chapter 3, Thermocouples, Thermometers, or Pyrometers."

Appointments

The following appointments were reported for record:

Leadership in Professional Divisions, Alfred Iddles, chairman, K. H. Condit, Linn Helander, Francis Hodgkinson, and W. R. Woolrich; 1940 Group Conferences: Group I, New Haven, November 2, Francis Hodgkinson and Alfred Iddles; Group II, New York, October 17, Francis Hodgkinson; Group III, Bethlehem, Pa., October 19–20, K. M. Irwin and W. H. Winterrowd; Group IV, Birmingham, Ala., October 25–26, J. W. Eshelman and S. B. Earle; Group V, Cleveland, October 19–20, J. H. Herron; Group VI, Milwaukee, October 26–27, Linn Helander; Group VII, Portland, Ore., Oct. 26–27, W. Lyle Dudley; Group VIII, Dallas, Tex., October 19–20, W. R. Woolrich. National Conference on Engineering Positions, W. F. Carhart, Walker L. Cisler, H. B. Oatley, and R. L. Sackett. Economic Status of the Engineer, W. S. Magalhaes, junior member of committee. A.S.T.M. Committee D-5 on Coal and Coke, R. M. Hardgrove. E.C.P.D. Delegatory Committee, Region I, C. Harold Berry; Region II, R. L. Spencer. National Council of State Boards of Engineering Examiners, Annual Meeting, Charleston, S. C., October 28–31, V. M. Palmer. Conference on Industry and Government, Union College, Schenectady, N. Y., October 15–16, A. R. Stevenson, Jr. Northeastern University, Boston, Inauguration of Dr. Carl S. Ell, as President, Nov. 19, H. N. Davis, and I. E. Moultrop. University of Illinois, Dedication of State Natural Resources Building, Urbana, Ill., Nov. 15, O. A. Leutwiler.

Meeting of Dec. 6

At a meeting of the Executive Committee of the Council of The American Society of Mechanical Engineers, held at the Hotel Astor, Sunday, Dec. 1, 1940, there were present Warren H. McBryde, chairman; James W. Parker, vice-chairman; Kenneth H. Condit, Clarke Freeman, and W. H. Winterrowd; A. J. Kerr (Local Sections), Harte Cooke (Professional Divisions); William A. Hanley, president-elect; and C. E. Davies, secretary.

Only a few matters of general interest were considered. It was reported that inasmuch as the American Engineering Council was incorporated in the District of Columbia, its termination would require court action, which could not be consummated by Dec. 31, 1940. Some continuing organization to cover the period that will elapse before legal termination of the A.E.C. can be effected was therefore necessary.

The Committee voted to extend to March 1, 1941, the time in which payment of dues in arrears would be received.

It was reported that the nomination of George Westinghouse to the Hall of Fame had been voted on but that the 65 votes necessary for election had not been cast. Under a rule of the electors of the Hall of Fame, however, a nomination which receives more than 20 votes in an election is automatically considered for the next election, which will be held in five years. As Mr. Westinghouse received 38 votes, his name will be voted upon again at the next election.

The Secretary reported that word had been received from The Institution of Mechanical Engineers that Aurel Stodola, of Zurich, Switzerland, had been awarded the James Watt International Medal.

1941 Executive Committee Organized

The organization meeting of the 1941 Executive Committee of the Council of The American Society of Mechanical Engineers was held in the rooms of the Society on Dec. 6, 1940. There were present: William A. Hanley, chairman; Kenneth H. Condit, Clarke Freeman, K. M. Irwin, and W. H. Winterrowd; and C. E. Davies, secretary. Mr. Condit was appointed vice-chairman of the committee.

Library Staff Prepares Defense-Training Bibliography

A "BOOK list" on "Engineering Defense Training" has been prepared by Harrison W. Craver, director, and Harrison A. von Urff, of the staff of the Engineering Societies Library for the American Library Association. The book list covers the fields of aeronautical engineering, industrial management, machine-shop practice, naval architecture, and marine engineering. Bibliographies, books, special publications, and periodicals are listed. Copies of the book list may be purchased from the American Library Association, 520 North Michigan Ave., Chicago, Ill.

Woman's Auxiliary to A.S.M.E. Enjoys Successful Annual Meeting Program

THE seventeenth annual meeting of the Woman's Auxiliary to The American Society of Mechanical Engineers convened in New York City at the Hotel Astor during the week of December 2, 1940. Mrs. Collins P. Bliss, general chairman with her vice-chairman, Mrs. Arthur C. Coonradt, and her Committee planned and carried through a most enjoyable program.

On Monday noon, Dec. 2, in the lobby of the Engineering Societies Building many of the women attended the unveiling of a tablet to Dr. Calvin Winsor Rice, the founder of the Woman's Auxiliary. Prof. C. F. Scott told of his work with Dr. Rice and of his vision and success in the building of the Engineering Societies Building.

"Behind the Scenes" at Macy's

In the afternoon Mrs. R. B. Purdy, chairman of the Excursions Committee, planned a trip "Behind the Scenes" through Macy's department store, and later Mrs. C. B. Le Page, chairman for Monday evening events, was responsible for dinner served in the attractive National Woman's Republican Club. From there the group went to hear the "Voice of Firestone" and later to Radio City Music Hall.

Tuesday at 11 a.m. at the Hotel Astor, the Woman's Auxiliary held its annual meeting. Both Mr. McBryde, the retiring president, and Mr. Hanley, the president-elect of The American Society of Mechanical Engineers, addressed the Auxiliary. It was pleasant to hear both men credit the group with being an aid to the parent body. The Auxiliary then stood in silent tribute to the memory of Mrs. Arthur Bruckner, who died suddenly in Washington.

With real regret, the Auxiliary realized that our retiring president, Mrs. George W. Farny who had been requested to serve three years would relinquish her duties. A true leader, she has expanded the organization to five sections, has initiated the news-letter, and has also created the Calvin W. Rice Memorial Scholarship.

The recipient of the first scholarship, Mr. Abril of Argentina, attended the Annual Meeting as the guest of the "Old Guard" of the A.S.M.E. Mrs. Farny announced a second Calvin Rice Scholarship to be given to a South American student this coming spring. Mrs. J. A. Brooks, chairman of the Calvin Rice Scholarship, read a letter from the Consul General of Ecuador asking that a student from that country be considered for this scholarship. She expressed the hope that this be made an annual scholarship.

Over 47 Students Helped Financially

The committee is cooperating with the Cultural Relations Department of the Department of State at Washington. Mrs. R. V. Wright, chairman of the Educational Loan Fund, reported that to date loans of over $10,000 have been made to 47 students in 16 different universities and colleges and of this number 22 have been repaid. One student said that only because of the loan from the Auxiliary is he now able to hold his present responsible position. As this fund is now a revolving fund, the treasurer, Mrs. A. H. Morgan, in her report suggested that all money raised for the coming year be given to the Calvin Rice Scholarship Fund in order to assure a third scholarship.

With much regret, the Auxiliary learned of the illness of Mrs. J. P. Harbeson, Jr., the fourth vice-president and chairman of the Philadelphia Section. In her absence Mrs. E. F. Zeimer, the vice-chairman, read an excellent report. Their contribution to the Calvin Rice Memorial Scholarship Fund was reported, also an increase of membership, which is now 44. Another regret was that Mrs. T. F. Githens, chairman of the Cleveland Section, was absent because of illness in the family. Mrs. V. M. Frost, sponsor of the Cleveland Section, reported that $25 had been donated to the Student Loan Fund, $5 to the Finnish Relief Fund, and that the Section had a membership of 29. The newly elected officers of the Cleveland Section for 1941 are Mrs. T. F. Githens, chairman; Mrs. J. H. Herron, vice-chairman; Mrs. E. B. Heavilon, secretary; and Mrs. Walter Barkley, treasurer.

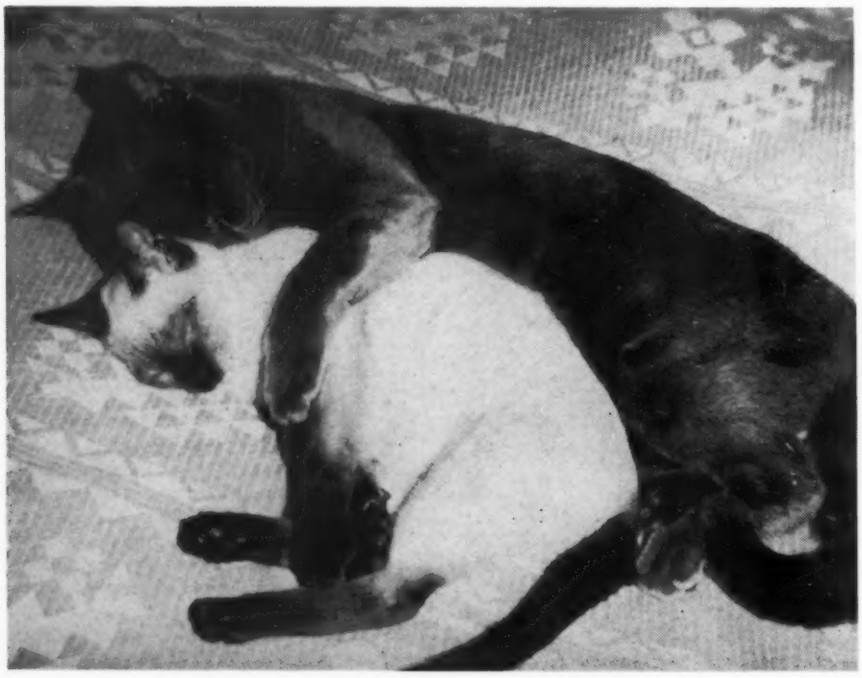
Mrs. Crosby Field, sponsor of the Los Angeles Section, read the encouraging report of the secretary, Mrs. S. S. Hansen, who wrote that the membership is now 27. Mrs. E. C. M. Stahl, chairman of the Metropolitan Section, reported a donation of $50 to the Calvin Rice Scholarship Fund, $111.50 to the General Fund, and a membership roll of 104. Mrs. Victor Spangler, chairman of the tellers of the Section, announced the re-election of the present officers for 1941. Mrs. E. C. M. Stahl, chairman; Mrs. J. N. Landis, first vice-chairman; Mrs. R. B. Purdy, second vice-chairman; Mrs. Webster Tallmadge, third vice-chairman; Mrs. C. H. Young, recording secretary; Mrs. A. C. Coonradt, corresponding secretary; Mrs. C. E. Gus, treasurer.

Officers for 1941

Miss Burtie Haar, chairman of the tellers for the election of the officers for the Auxiliary, announced the officers for the year 1941 as follows: Mrs. F. M. Gibson, president; Mrs. E. C. M. Stahl, first vice-president; Mrs. A. R. Cullimore, second vice-president; Mrs. Crosby Field, third vice-president; Mrs. J. P. Harbeson, Jr., fourth vice-president; Mrs. J. H. Herron, fifth vice-president; Mrs. C. H. Young recording secretary; Mrs. C. H. Fay, corresponding secretary; Mrs. A. H. Morgan, treasurer; and Mrs. R. F. Gagg, assistant treasurer. The meeting approved a motion that each section concern itself with some phase of war work. Mrs. Farny introduced the incoming president, Mrs. F. M. Gibson, who with much earnestness pledged her efforts to serve the Auxiliary and who also paid a glowing tribute to Mrs. Farny. The Auxiliary gave Mrs. Farny a rising vote of thanks for her outstanding service and the meeting adjourned to attend the Annual Luncheon at the Hotel Pierre.

At the request of Mrs. G. L. Knight, chairman, Miss Ethel Traphagen of the Traphagen School of Fashion, presented a novel pageant "Historic Moments in America" modeled by the students of the school. The costumes of the South Americas were of timely interest. The finale was most inspiring, "Miss New York" with our own "Old Glory."

An interlude was a visit to the Museum of



"HO-HO" AND "MEE-TOO"

(Photograph taken by C. H. Durkee and shown at the Fifth Annual Photographic Exhibit held during the A.S.M.E. Annual Meeting, Dec. 2–6, 1940, New York, N. Y.)

Modern Art before attending an informal dinner at the Engineering Woman's Club, arranged by Mrs. Crosby Field, chairman of the Tuesday evening events. Mrs. W. A. Becker, honorary president of the Daughters of the American Revolution, told of their activities.

On Wednesday an interesting trip was taken through the furniture factory of Schmeig and Kotzian. Later lunch was served at the Airport Terrace Restaurant and an inspection trip made of the LaGuardia Airport and the American Airline hangars.

Annual Tea and Cocktail Party

The hospitable prelude to the Dinner of the A.S.M.E. was an annual tea and cocktail party at the Hotel Astor under the guidance of the gracious chairman, Mrs. Charles E. Gus. This year the decorations in the grand ball room for the Annual Dinner were especially striking. The arrangement of our own American flag with other colorful flags accompanying it, was a beautiful and not-to-be-forgotten setting for the many honors distributed that evening.

On Thursday morning the women enjoyed a guided tour through the newly enlarged New York Historical Society and in the afternoon the annual meeting concluded with a trip through the new S. S. *America*.

BURTIE HAAR
Chairman, Publicity Committee

L. L. Lewis Heads A.S.R.E.

L. L. LEWIS, vice-president in charge of engineering, Carrier Corporation, Syracuse, N. Y., and one of the early pioneers in air conditioning, was elected president of the American Society of Refrigerating Engineers on Dec. 5, 1940, at the final session of the 36th Annual Convention of the Society at the Hotel Commodore, New York.

He succeeds George E. Hulse, member of the Council of The American Society of Mechanican Engineers, as president.

I.B.R. Research Home

ANNOUNCEMENT has been made of the construction of a "research home" at the University of Illinois, financed by 13 of the manufacturers of cast-iron boilers and radiators who are members of The Institute of Boiler and Radiator Manufacturers, R. E. Ferry, general manager, 60 East 42nd Street, New York, N. Y.

The purpose of the research project is to conduct studies with steam and water heating systems and related equipment in actual home-use conditions, and to investigate the possibilities of reducing installation costs in connection with low-cost housing. Another important part of the program, the announcement says, is to carry out a cooling-research project in which the most recent developments of steam and hot-water heating equipment will be combined with equipment suitable for obtaining reduced temperatures in the home during summer months.

A.S.M.E. COMMITTEE ON LOCAL SECTIONS FOR 1941
(*Standing, left to right:* F. W. Marquis, Ernest Hartford, J. A. Keeth. *Sitting, left to right:* J. N. Landis, H. L. Eggleston, chairman, and F. L. Wilkinson, Jr.)

Akron-Canton Section Hears Major Reedall Talk on "Industrial Mobilization"

On Dec. 6, 1940, 75 members and guests of the Akron-Canton Section were much interested in a talk by Major H. M. Reedall on "Industrial Mobilization." Major Reedall was a witty as well as an informative speaker, with comprehensive experience in the Ordnance Department and a keen knowledge of ordnance problems not only in the Cleveland District but also in the nation. He told of the procurement methods as they are today as compared with those of the last war and said that efforts toward simplification of specifications, standardization, and coordination of new ideas are being made. For an hour following his talk Major Reedall led a lively discussion of the matter.

Anthracite-Lehigh Valley Members Meet in Allentown

THE November meeting of the Anthracite-Lehigh Valley Section was held on the 22nd in Allentown, Pa. An audience of 65 members and guests listened to a paper on "Preventive Maintenance in the Operation of Motor Vehicles," given by Belden H. Eaton. Mr. Eaton showed how this method of maintenance made it possible to reduce the lost time of 250 vehicles from 300 hours per year to 20 hours.

Baltimore Section Members Meet With Investment Bankers

On Nov. 25, the Baltimore Section held a joint meeting with the Southeastern Group of the Investment Bankers Association of America. More than 100 engineers and bankers gathered at the Engineers Club to hear Emmett F. Connely, president of the association, speak on "The Engineer's Function in Industrial Financing." At a dinner preceding the talk, F. A. Allner, president of the Safe Harbor Water Power Corp., made a short address and introduced many of the members of both professions. The meeting was presided over by George W. Keen, chairman of the Section, and William Price, chairman of the bankers' group.

S.R.O. at Bridgeport Meeting

Bridgeport Section had the largest meeting of its existence on Nov. 19 when more than 200 members and guests came to honor Warren H. McBryde, President of the A.S.M.E., and to hear Prof. Joseph W. Roe, member A.S.M.E. Using for demonstration a group of more than 100 jigs and fixtures furnished by members present, Professor Roe set forth the fundamentals of jig and fixture design. Credit for the success of the meeting is due Rudolf Beck, vice-chairman of the Section, and chairman of the Program Committee.

Gas Turbines Described to 140 Buffalo Engineers

Gas turbines was the subject of the paper presented by W. O. Lowell, chief engineer of the gas-turbine division, Allis-Chalmers Mfg. Co., before 140 members and guests of the Buffalo Section on Nov. 19. He explained the principle of the gas turbine and its many applications.

Central Indiana Section Has Joint Two-Day Meeting

The Central Indiana Section held a two-day joint meeting with the Indiana Engineering

Council in Fort Wayne, Ind., Nov. 15–16. More than 350 engineers, including many members of the A.S.M.E., were present.

Research, Steam, and Auto Drive Discussed at Chicago

Preceding the meeting on Nov. 6, the executive committee of Chicago Section honored Warren H. McBryde, President of the A.S.M.E. at a dinner. At the meeting, President McBryde spoke briefly to the 125 members and guests who were present. The speaker of the evening, H. H. Metzel, Olds Motor Division, General Motors Corp., showed a series of motion pictures and described the design of the hydramatic drive, a combined clutch and differential transmission.

At the Nov. 12 meeting, Prof. J. I. Yellott, member A.S.M.E., illustrated with slides and colored motion pictures his research on steam flow through nozzles and orifices. There were 62 present at this session.

On Nov. 20, Prof. Harold Vagtborg, director of the Armour Research Foundation of the Illinois Institute of Technology, and associates discussed or demonstrated 25 items relative to "Research Tools," the subject of the meeting. Marvin Camras surprised L. W. Wallace, chairman of the meeting, when he played back to him a steel-wire record of his introductory remarks at the beginning of the session. Dr. H. A. Leedy demonstrated photoelectric and sound-level meters and recorders. Dr. H. G. Fiske showed recent developments of the electron microscope, spectroscopy, and the petrographic microscope. Topics discussed by Professor Vagtborg included wetting agents, ultra centrifuge, X-ray diffraction, and grating machines.

Navigation Is Topic of Cleveland Section Meeting

The program at the Nov. 14 meeting of the Cleveland Section consisted of an interesting talk by Lieut.-Com. R. E. Wood, U.S.C.G., on the mechanics of inshore and offshore navigation. He explained the various types of charts, instruments, and harbor markers, and their use to the ship commander in navigation.

PRESIDENT MCBRYDE AND PRESIDENT-ELECT HANLEY

Colorado Members and Ladies Brave Storm

Despite a sleet storm and icy roads, 16 members and ladies attended the Nov. 22 meeting of the Colorado Section at the Albany Hotel in Denver. B. A. Oxnard traced sugar from its earliest known existence to the present, particularly beet sugar. He explained the quota system, the use of by-products to feed cattle, and the method of growing the beet. H. L. Hartburg described the process of extracting the sugar from the beet, losses in storage of beets, problems in receiving, transporting, cleaning, weighing, and slicing, diffusion process, presses, evaporators, and other allied equipment.

Army Air Corps Training Topic of Columbus Meeting

Capt. J. L. Williams spoke to 50 members and guests of Columbus Section on Nov. 15. His subject was the method of training young men for the army air corps, both as pilots and as mechanics.

Erie Hears Engineers Are Key Men in National Defense

At the Nov. 15 meeting of the Erie Section, 30 members and guests heard L. A. Codd, editor of *Army Ordnance* and a Lieutenant-Colonel, Ordnance Department Reserves, U. S. Army, talk on the subject of "Industrial Mobilization for Defense." He showed that our country's industrial mobilization is following a very definite and efficient plan and that our engineers are the key men in "tooling up" American industries.

Kansas City Chairman Heads New Group VIII

Following a dinner on Oct. 25, it was announced at the meeting of the Kansas City Section that Chairman H. L. Crane was elected chairman of the new Group VIII Conference in Dallas, Texas, and also senior delegate to the 1940 Annual Meeting of the Society. The speaker of the evening was Leonard Jurden, regional director of the Civil Aeronautics Authority, who described the work of his organization.

150 Members and Guests at Los Angeles Section Session

More than 150 members and guests attended the Nov. 14 dinner meeting of the Los Angeles Section. Paul Beemer, production manager, Pacific Railway Equipment Co., described the features of the new streamlined, lightweight, all-welded cars which are suspended on the trucks above their center of gravity. After the meeting, an inspection trip was made through the company's plant. According to Edmond M. Wagner, secretary of the Section, this meeting and trip was the best yet held by the Section.

Louisville Section Holds National Preparedness Meeting

The National Preparedness Meeting of the Louisville Section on Nov. 11, attended by 80 members and guests, featured two speakers, Charles D. Harmon, National Machinery Co., and Ernest Hartford, assistant secretary of the Society. After two motion-picture films on the forging and manufacture of shells were shown, Mr. Harmon described present-day machines and processes. Mr. Hartford told of the work of the A.S.M.E. in National Defense.

Memphis Section Prepares Extensive Program for Year

After Mack D. Rust, chairman of the Memphis Section, gave a report of the Group IV Conference at Birmingham, Ala., at the Nov. 8 meeting, members discussed the program for the year. It is planned to have plant visits, motion pictures, and interesting speakers, to be secured through Society headquarters.

Photoelasticity Discussed Before Milwaukee Section

Photoelasticity as applied to design problems was the subject of the talk and demonstration given on Nov. 19 before 110 members and guests of the Milwaukee Section by Dr. O. J. Horger, Timken Roller Bearing Co. He presented his topic in the following order: (1) Photoelasticity to determine good shape; (2) fatigue tests (full scale) to check percentage gain in fatigue strength; and (3) vibration studies with motion pictures.

Linn Helander and Lorenz Straub Speakers at Minnesota Section

The Oct. 28 meeting of the Minnesota Section was held at the University of Minnesota. After a discussion of Society affairs by Prof. Linn Helander, manager of the A.S.M.E., Rueben Olson, student member A.S.M.E., presented several ocarina selections. Then Professor Helander gave his paper on "Factors in the Design and Operation of Steam Power Plants," which was illustrated with lantern slides. He stressed the importance of power in the National Defense Program and stated that because of the emergency engineers are more interested in capacity available than efficiency, leading to a decided trend toward standardization of pressures and temperatures.

Dr. Lorenz Straub, chairman of the Minnesota Section, presided at the regular monthly meeting on November 25 when 24 members and guests were present. Prof. T. P. Hughes, of the department of mechanical engineering at the University of Minnesota and chairman of the Northwest chapter of the American Welding Society, gave an illustrated talk on "Welding, Industry's New Tool." He outlined the various methods of welding used and pointed out its importance to industry to-

day in that it is finding increasing favor for shipbuilding and structural uses. He closed his exceedingly interesting talk with a comparison of the relative costs and practicability of forging, casting, and welding, with emphasis on the merits of each for certain types of work. An open forum discussion followed.

Seeing the Unseen Topic of Norwich Meeting

At the Nov. 14 meeting of the Norwich Section, attended by more than 100 members and guests, H. W. Lamson, General Radio Corp., explained the stroboscopic principle in detail, presented information on fields of application of the instrument, and demonstrated two models. Motion pictures on the subject were then shown.

450 In Philadelphia Hear About Aircraft Production

T. P. Wright, director of engineering, Curtiss-Wright Corp., was the speaker at the Nov. 26 meeting of the Philadelphia Section, which was attended by 420 members and 30 visitors. Taking as his subject, "Aircraft Production," Mr. Wright covered in a very direct manner our aircraft needs, pointed out the different types of planes, and discussed the cost and plants necessary to produce the quantities required for the future. Discussers included W. Lawrence LePage, Carl DeGanahe, R. H. Prewitt, and E. B. Wilford.

Providence Has 250 at Meeting on Eclipse

More than 250 members and guests of Providence Section turned out on the evening of Nov. 25 to hear Prof. Charles H. Smiley, Brown University, give a detailed account of his recent trip to Brazil to view the solar eclipse. Even though clouds hid the scene from the eyes of the observers, new types of photographic films were able to record the phenomenon.

Gisholt Plant Inspected by Rock River Valley Members

Following a dinner on Nov. 22, 62 members and guests of the Rock River Valley Section saw two motion pictures as well as slides of balancing machines manufactured by the Gisholt Machine Co., and heard a description of them by Werner I. Senger, development engineer of the company. The meeting was followed by an inspection trip through the plant.

Nov. 1 Meeting of East Tennessee Held in Elizabethton

The East Tennessee Section held its second meeting of the season on Nov. 1 at Elizabethton, Tenn. There were 63 present for the luncheon meeting and 54 for the dinner meeting. After an address of welcome by Elmer Torok, Dave R. Shearer, district manager of the Tennessee Eastern Electrical Co., discussed "The Engineer and Human Progress" at the luncheon. In the afternoon, inspection trips were made by some through the Tennessee country and by others through the filtration plant and powerhouses of the North American Rayon Corporation, and American Bemberg Corp. At the dinner meeting, C. E. Joos, Cochrane Corp., spoke on "Feedwater Conditioning," and J. I. Taylor, North American Rayon Corp., discussed "Modern Production Engineering."

New Refining Processes Discussed at Toledo

L. P. Ferguson, Standard Oil Co. of Ohio, was the guest speaker at the Nov. 14 meeting of the Toledo Section. He gave a comprehensive talk on the advancement of petroleum refining, using slides to illustrate his various points. Some of the topics covered were cracking, polymerization, and catalytic agents.

Warren H. McBryde Is Guest of Utah Section

Warren H. McBryde, President of the A.S.M.E., was the guest of honor at a dinner meeting of the Utah Section on Oct. 31. He discussed briefly the various accomplishments of the Society during the last year and its bearing on each member. At the Nov. 19 meeting of the Section, motion-picture films on rubber were shown.

Virginia Section Meets With Student Branches

The Virginia Section held a joint meeting with the A.S.M.E. Student Branches of the University of Virginia and Virginia Polytechnic Institute on the campus of the latter school on Nov. 9. There were 181 engineers and students in attendance. G. C. Molleson, chairman of the Section, described the City of Richmond's new marine terminal in an illustrated talk. Four other papers were presented by V.P.I. student members.

Waterbury Holds Joint Affair With New Haven

Plastics was the subject of the Nov. 19 joint meeting of the Waterbury and New Haven Sections at Yale University. W. Reibold, talking on the state of the art, outlined the diversified types of plastics now available and discussed their particular properties and applications. A. Bollman described modern die casting and improvements relative to growth in aging and to impact resistance. A. W. F. Green talked on modern metals, especially as used in air-cooled radial aircraft engines.

Western Washington Has 71 at Nov. 13 Meeting

Prof. G. S. Schaller talked before 71 members and guests of Western Washington Section at the Nov. 13 meeting. He traced the development of aluminum from its early discovery through its many years as a precious metal until Hall's discovery of a cheap recovery method. Also discussed were the present aluminum alloys and their applications.

A.S.M.E. Calendar

of Coming Meetings

March 31–April 3, 1941
Spring Meeting
Atlanta, Ga.

June 16–20, 1941
Semi-Annual Meeting
Kansas City, Mo.

October 13–15, 1941
Fall Meeting
Louisville, Ky.

December 1–5, 1941
Annual Meeting
New York
N. Y.

(*For coming meetings of other organizations see page 24 of the advertising section of this issue*)

A.S.M.E. Local Sections

Coming Meetings

Akron-Canton. January 9. M. O'Niels' Tea Room, dinner at 6:45 p.m.; meeting at 8:00 p.m. Subject: "The Practical and Technical Science of Metallic Finish," by D. A. Wallace, president of sales division of Chrysler Corporation, Detroit, Mich.

Anthracite-Lehigh Valley. January 24. Packard Laboratory, Lehigh University, Bethlehem, Pa., at 8:00 p.m. Executive Committee meeting at 4:00 p.m.; dinner at 6:00 p.m. at the Old Sun Inn. Subject: "Air Conditioning of Industrial Plants," by S. Martin, Jr., manager, contractor sales division, air-conditioning department, General Electric Co., Bloomfield, N. J.

Baltimore. January 27. Engineers Club of Baltimore, Baltimore, Md. Subject: "Apprenticeship Training," by Donald Lane, Bethlehem Steel Company, Bethlehem, Pa.

Buffalo. January 15. University Club at 6:30 p.m. This will be a joint meeting with the American Institute of Electrical Engineers. Subject: "Glass and Its Engineering Application," by Dr. Phillips, Corning Glass Co., Corning, N. Y.

Central Indiana. January 17. Athenaeum, Indianapolis, Ind., at 6:30 p.m. Dinner will be served at 6:30 p.m. in one of the private dining rooms and will be followed by the meeting in the auditorium at 8:00 p.m. Subject: "Manual and Manufacturing Operations" (illustrated by a colored film), by Fred L. Pyle, operating engineer, Link-Belt Co., Chicago, Ill.

Chicago. January 10. Meeting to be sponsored by the Manufacturing Division of the Section; dinner meeting. Speaker: W. L. Batt, president of the SKF Industries, Inc., Philadelphia, Pa., and past-president A.S.M.E.

January 14. Meeting sponsored by the Transportation Division of the Chicago Section.

January 21. Meeting Sponsored by the Junior Group of the Chicago Section.

Detroit. January 7. Downtown Club, Penobscot Building at 7:30 p.m. Annual Ladies' Night Meeting. Subject: "Detroit's Traffic Problem," by D. Grant Mickle, traffic engineer, City of Detroit, Detroit, Mich.

Mid-Continent. April (second week). Michaels Cafeteria at 5:30 p.m. E. S. Burnett, senior engineer of the U. S. Bureau of Mines, will speak. W. R. Holway, consulting engineer of the W. R. Holway Co., will discuss the Grand River Dam.

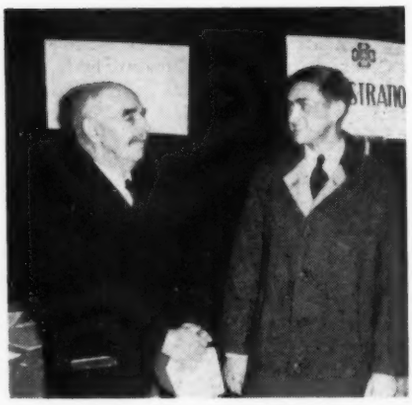
Ontario. January 9. Hart House, University of Toronto, Toronto; dinner at 6:15 p.m.; meeting at 7:30 p.m. Subject: "Development of Combustion and Boiler-Control Equipment," by Paul Dickey, Bailey Meter Co., Cleveland, Ohio.

Philadelphia. January 28. Engineers Club of Philadelphia, 1317 Spruce St., Philadelphia, Pa., at 7:45 p.m. Subject: "New Engineering Materials," by C. P. Kidder, du Pont Company, and Thomas D. Perry, Resimons Products & Chemical Co., Inc. There will be an exhibit of new materials at the meeting.

Toledo. January 9. University of Toledo, room 401, Toledo, Ohio, at 8:00 p.m. Subject: "Materials Testing—Testing Equipment," by C. H. Gibbons, Baldwin-Southwark Division of the Baldwin Locomotive Works, Philadelphia, Pa.

Washington, D. C. January 11. Potomac Electric Power Company Auditorium at 8:00 p.m. Subject: "Armament Production," by E. D. Duckett, Commander, U.S.N., and R. E. Robinson, Commander, U.S.N., respectively assistant production officer and officer-in-charge, design and drafting division, Naval Gun Factory, Washington, D. C.

Waterbury. January 8. Hotel Elton, Waterbury, Conn., at 8:00 p.m. Subject: "Yankee Ingenuity Versus Modern Engineering," by Richard A. North, chief engineer of the Farrel-Birmingham Co., Inc., Ansonia, Conn.



WILLIAM B. BURLINGAME AND HIS GUEST

(Mr. Burlingame of Exeter, N. H., brings a student guest to every Annual Meeting. This time Lee H. Taylor who attends high school at Exeter is enjoying the meeting.)

With the Student Branches

Speakers at British Columbia

ACCORDING to reports received from BRITISH COLUMBIA BRANCH for the months of October and November, talks were presented at the weekly meetings on the following subjects: "High-Pressure Steam Locomotives," by C. W. Parker; "Drop Hammers and Hydraulic Presses for Aircraft Production," by Herbert Kelland; "Construction of Steel Ships," by T. A. McLaren; "The Akimoff Method of Dynamic Balancing," by John Gillies; "Treatment of Rayon Pulp," by S. C. Rooney; "The Almy Boiler," by W. E. Mills; "Locomotive Valve Gears," by A. Turnbull; and "Economic Application of Housing Insulation," by G. S. Wade.

BROWN BRANCH held its first meeting of the term on Nov. 5. After a brief talk by Professor Berard, honorary chairman, on the advantages and the functions of the A.S.M.E., Richard O. Love, chairman of the Branch, announced a contest in which a prize will be presented for the best paper given on or before Dec. 16, at one of the weekly meetings on Tuesday.

CALIFORNIA BRANCH held a joint meeting with the I.Ae.S. chapter on Nov. 7 at which 65 A.S.M.E. members were present. The speaker of the evening was Carlton Bioletti, aeronautical engineer at Moffett Field, who discussed "The Aims of the Aeronautical Laboratory at Moffett Field." At the conclusion of his talk, he showed motion pictures of the work being done at the Langley Field laboratories.

California Tech Holds Trips

On Nov. 1, the student members of CALIFORNIA TECH BRANCH visited the packing plant of the Walnut Growers Association in Los Angeles where they saw automatic handling equipment and hydraulic nutcrackers. The trip on Nov. 8 was to the Vernon plant of the Axelson Manufacturing Company. In the engineering department and shops the boys were able to follow from beginning to end the construction of heavy-duty, geared engine lathes and oil-field equipment.

MEMBERS OF THE STUDENT BRANCH AT CLARKSON COLLEGE OF TECHNOLOGY ON A TRIP TO A PLANT OF THE NIAGARA-HUDSON POWER COMPANY ON NOV. 16

CATHOLIC UNIVERSITY BRANCH had Capt. B. S. Mesick, U. S. Army, as the speaker on Nov. 13. He described the design of antitank guns, antiaircraft guns, and mobile field units. The lecture was illustrated with slides showing the progress made in the design of guns.

CLARKSON TECH BRANCH reports that as of Nov. 16, already 55 students have become members of the A.S.M.E. Branch. Much of this is due to the interesting meetings and inspection trips arranged by the Program Committee.

CLEMSON BRANCH devoted its meeting of Nov. 20 to a discussion of the whys and wherefores for the collapse of the Tacoma Bridge. Because of the conflict with the meetings of other school organizations, the meetings of the Branch will hereafter be held on Monday evening instead of Wednesday evening each week.

Talks Given Before Colorado State

Magnesium and its alloys was the subject of the paper given before the COLORADO STATE BRANCH on Nov. 4 by Prof. Alfred Schmidt. After the meeting, the 25 members and guests adjourned to the mechanical-engineering laboratory where lunch was served. On Nov. 18, Wayne Argabrite, student member, gave a lecture and demonstration on various types of microphones.

COLORADO BRANCH members met on the evening of Nov. 27 to listen to a talk on gasoline and additives by A. T. Johnson, Ethyl Corporation. He illustrated his talk with motion pictures.

COOPER UNION BRANCH (day) at its meeting on Nov. 13 had as guest speaker, L. J. Parsons, Consolidated Edison Co. of New York, who talked on "Power Generation for the City of New York." His paper was illustrated with slides and charts which were distributed to the 50 members and guests present.

A FEW OF THE 100 STUDENTS PRESENT AT THE NOV. 20 GET-TOGETHER MEETING OF THE COOPER UNION BRANCH (DAY) AT WHICH DEAN GEORGE F. BATEMAN WAS THE GUEST SPEAKER

H. H. Snelling at Cornell

Henry H. Snelling, past vice-president A.S.M.E., spoke on Nov. 26 before the CORNELL BRANCH on the subject of "Experimenting Before Patenting." Among the points discussed was whether an inventor should experiment before patenting his invention and risk the chance of someone applying for a patent before him or whether he should apply for a patent while the invention is in the "half-baked" stage.

DREXEL BRANCH had 60 members present at the Nov. 7 meeting to hear a talk by R. G. Sloan, Petrol Diesel, Inc., on the design of small Diesel generating sets. At the close of the interesting talk, refreshments were served to the audience.

The Student Branch of the new ILLINOIS INSTITUTE OF TECHNOLOGY at a special meeting on Oct. 31 welcomed Warren H. McBryde, President of the A.S.M.E. To an assemblage of 200 members and guests. President McBryde expounded the general development of engineering from the earliest of times to the present day, with a continuous flow of historical anecdotes that alternately amused and amazed his audience with their seeming unreality.

University of Illinois Branch Makes Four-Day Inspection Trip

Members of the UNIVERSITY OF ILLINOIS Branch met on Nov. 13 to hear Mr. R. R. Fowler of the Ethyl Gasolene Corporation explain the part his company played in the automotive and petroleum industries. He also demonstrated a small gasoline engine operating alternately on a modern fuel and an outmoded fuel. Members of the Branch made a four-day inspection trip starting on Nov. 6 to industrial plants in the vicinity of Chicago and Milwaukee. Among the plants visited were those of the Western Electric Co., Electro-Motive Corp., Wisconsin Steel Works, International Harvester Co., Allis-Chalmers Mfg Co., and Kearny & Treacker Co. On Nov. 27 a joint meeting of the A.S.M.E. and A.I.E.E. Branches was held to determine which of the two had the most "intelligent" members. Four men from each Branch took part in the oral quiz which had been prepared by faculty members of both departments. Out of a possible 2800 points the mechanicals got 1068 and the electricals 1139 so they were presented with a miniature loving cup by Prof. E. B. Paine head of the electrical-engineering department.

IOWA BRANCH during the last few weeks has featured papers by J. Blessin, Ted Schroeder, E. A. Slindee, W. Jackson, W. R. Chapman, D. R. Schamp, R. W. Matson, E. J. Hicks, Don Spencer, J. Hamilton, L. Jilly, and T. McCaw.

Iowa State Gets Job Advice

As a feature of the Nov. 19 meeting of the IOWA STATE COLLEGE BRANCH, Don Stevens, personnel manager of the school, led a dis cussion on jobs and interviews. He advised the seniors to pick their company and get the job since the demand for engineers this year is greater than ever

KANSAS STATE BRANCH members selected William Bixler as the outstanding mechanical engineering student for this year and presented him with a set of Kent's Handbooks.

KENTUCKY BRANCH presented an interesting program at its Nov. 15 meeting. John Dicker exhibited three motion pictures, one on astronomy, one on the moon, and the last showing the earth in motion.

500 Attend Lafayette Meeting

Sponsored by the LAFAYETTE BRANCH, The Franklin Institute presented on Nov. 19 to 500 members and guests its lecture demonstration on flight. The various topics covered included the analysis of a bird in flight, various methods of flight utilized by man, airplane flight analysis, and actual flights of model airplanes around the auditorium.

LOUISVILLE BRANCH was host to 45 members of KENTUCKY BRANCH on Oct. 25. Following introductions, J. Rathburn gave a paper on "Recovery of Waste Heat for Diesel Engines." After the talk Robert Gray, chairman of the Louisville Branch, and Professor Fenwick outlined the program for the visitors and their hosts for the rest of the day.

MARYLAND BRANCH was host to Prof. A. G. Christie, past-president of the A.S.M.E., at a dinner and meeting on Nov. 12. He gave an illustrated lecture on the recent improvements in power and water supply in the City of Los Angeles. Of particular interest was his explanation of the novel features necessary in steam-power plants and water-supply systems to withstand shocks resulting from earthquakes. It is announced by Charles R. Beaumont, secretary of the Branch, that the Branch has a membership of 39 and that it expects to pass the 50 mark before the end of the school year.

Michigan Holds Banquet

In honor of Alex Dow, past-president of the A.S.M.E., MICHIGAN BRANCH held a banquet on Nov. 6. Unfortunately, Mr. Dow was unable to come at the last minute. Nevertheless, the banquet was held and Prof. A. E. White substituted as speaker for Mr. Dow at the meeting which followed. His subject was "Comparison of the Present and the First World War Ordnance Department of the U. S. Army." He predicted that every young mechanical engineer would be actively engaged in ordnance work in case of war.

MINNESOTA BRANCH held a meeting on Oct. 28 at which 75 members heard a talk by Prof. Linn Helander. He discussed the opportunities of engineers in the present National Defense Program and in the engineering field as a whole.

MISSISSIPPI STATE BRANCH held its second regular meeting on Nov. 6. Dean L. L. Patterson gave a short talk on the relationship between mechanical engineers in the present industrial program. After a short business session, motion pictures on internal-combustion engines were shown.

WARREN H. MCBRYDE, PRESIDENT OF THE A.S.M.E., SPEAKING BEFORE 200 MEMBERS AND GUESTS OF THE ILLINOIS INSTITUTE OF TECHNOLOGY BRANCH ON OCT. 31

Missouri Miners Get Welding Hints

Before 77 members and guests of MISSOURI MINES BRANCH on Dec. 3, Harry F. Brooker, Combustion Engineering Corp., related how the riveting of boilers was abandoned in favor of arc-welded seams so that heavier plates and consequently higher pressures could be utilized. It was amazing to note the strict inspection codes in effect and the expense encountered in X-ray and penetrameter inspections of heavy-shell seams in pressure vessels.

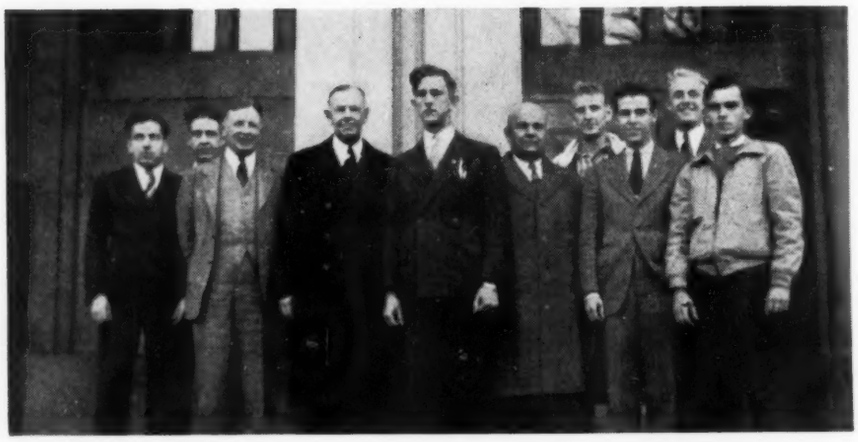
MISSOURI BRANCH reports that it had a speaker at each of the meetings held in October and November who spoke on a technical subject of interest to the student members. Several inspection trips are being planned for the near future.

NEBRASKA BRANCH had a Spanish Civil War flyer as its speaker on Nov. 13. He was Edward Lyons, chief flying instructor of the Lincoln Flying School, who served with the government forces. Particularly interesting were his descriptions of personal combat experiences in fighting German and Italian flyers.

Newark Has 240 at Meeting

On Nov. 13, Ensign B. W. Dunlop, U. S. Navy Reserve, presented several films before 240 members and guests of NEWARK BRANCH. The films shown were "Wings of Gold," portraying the air-training program of the navy at Pensacola, "The Gray Armada," depicting the fleet in action, and one showing submarines in service.

NEW MEXICO BRANCH met in the mechanical-engineering laboratory on Nov. 12. William Gilpin, superintendent, Albuquerque Gas & Electric Company, gave a talk on the problem of electrolytic corrosion in underground pipes and the various methods used in combating it.



PRESIDENT WARREN H. MCBRYDE AND L. W. WALLACE ARE WELCOMED ON NOV. 6 BY OFFICERS OF NORTHWESTERN STUDENT BRANCH AND FACULTY MEMBERS

N.Y.U. BRANCH (aero) presented Prof. F. K. Teichmann as the speaker at the Nov. 27 meeting. He spoke on "Modern Military Aircraft and Their Equipment." Functions and tactical uses of high-speed pursuit and bomber aircraft were particularly stressed. Aircraft used in the European War were described and discussed.

N.Y.U. BRANCH (mechanical) scheduled a smoker for the evening of Nov. 19 which was poorly attended because one of the professors on short notice announced a one-hour examination next day which made it necessary for most of the members to stay home from the smoker to study. Nevertheless, those present enjoyed the two sound motion pictures presented by the Consolidated Edison Co. of New York and the discussion which followed.

NORTH DAKOTA AGRICULTURAL BRANCH had two papers presented by student members at the Oct. 24 meeting. Bill Sheard gave a talk on "Higher Antiknock Fuels and How They Effect Present-Day Automobiles," and E. Wang told "How to Get More Tractor Power."

North Carolina Holds Joint Meeting

More than 100 members of NORTH CAROLINA STATE BRANCH and DUKE BRANCH gathered at the former school on Nov. 12 to hear Dr. Starr Truscott, research engineer with the N.A.C.A. After outlining the history and purpose of the Committee, Dr. Truscott showed motion pictures of tests made in a 2900-ft towing basin on boat hulls. It was said that many of the models cost from $3000 to $7000 apiece.

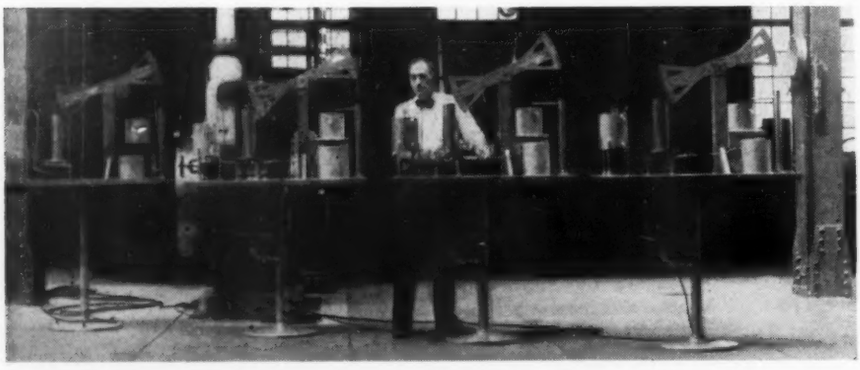
NORTHEASTERN BRANCH was honored with the presence of President Warren H. McBryde on Nov. 14. He spoke before 80 members and guests on "The Mechanical Engineer Yesterday, Today, and of the Future," stressing particularly the many problems which await the young engineer on his entrance into the world from the close confines of the classroom.

NORTHWESTERN BRANCH was also fortunate in having President Warren H. McBryde as its guest. To the 60 members and guests present, he gave an insight into the workings of the parent society, the employment service maintained by the Founder Engineering Societies, and the various publications available to engineers. As a bit of final advice, he admonished the boys to be "able to paddle their own canoes."

Ohio State Has 112 at Meeting

The meeting of OHIO STATE BRANCH on Nov. 15 was attended by 112 members, and featured motion pictures showing the history of automobile racing and aviation, and the manufacture of valves. Since so much interest was shown by the members, Louis Schultz passed around some sodium-cooled airplane valves.

OKLAHOMA A.&M. BRANCH met on Nov. 11 to hear Charles McCarthy, flight instructor at Stillwater Airport, talk on the present and future of aviation. A lengthy discussion followed the talk.



Models of Newcomen Engines Built at Lehigh

NO one has ever seen, working at one time in one place, four Newcomen engines, the cumbersome, slow-moving atmospheric pumping engines used in the coal mines of Great Britain prior to Watt's time. At the time of the celebration of the Watt Bi-Centenary (see MECHANICAL ENGINEERING, January and February, 1936) the department of mechanical engineering at Lehigh University constructed a working model of the Watt engine, now at the Packard Laboratory of that institution. Later a model of the Newcomen engine was constructed at Lehigh for the museum at Massachusetts Institute of Technology (see MECHANICAL ENGINEERING, December, 1939, p. 916). More recently four additional model Newcomen engines, shown in the illustration, were built for other institutions. These models are fitted with electrically driven air compressors so that they may be operated. Professor Larkin of Lehigh is prepared to build other models of Newcomen and Watt engines for museums and other institutions. One of the four models shown in the illustration was presented to the University of Alabama on December 6, 1940, by the Alabama Committee of the Newcomen Society, American Branch.

OREGON STATE BRANCH members heard about the Dutch East Indies at the meeting of Oct. 30. Ivan K. Nichols, oil geologist, who had spent three years there, told the students of the methods used in searching for oil in the jungle, the problems encountered in road construction, and the procurement and transportation of equipment. Mr. Nichols had come back to the United States because oil exploration work in the Dutch East Indies has been temporarily abandoned because of the Chinese-Japanese War.

PITTSBURGH BRANCH had M. G. Mochel, member A.S.M.E., as the speaker at the Oct. 31 meeting. He presented an interesting talk on "Gear Applications."

Pratt Branch Is Very Active

During the month of November the PRATT BRANCH had two interesting meetings. The first, on Nov. 4, with George F. Nordenholt, editor of *Product Engineering*, was devoted to the subject of "Problems of Design in Engineering." The talk was of particular value to the seniors who are now working on their theses. There were 51 members and guests present. At the meeting on Nov. 18, William Hargest, associate editor of *American Machinist*, talked on "Jigs and Fixtures in Aircraft Industries." The talk, heard by 60 members and guests, was illustrated with slides showing the assembly of modern aircraft.

PURDUE BRANCH had 500 members and guests present on Dec. 3 to see the technicolor motion-picture film, "Steel, Man's Servant," which portrayed the process of steel manufacture and distribution from mill to market.

RENSSELAER BRANCH had a meeting on Nov. 13 which was attended by more than 100 members and guests. Through the courtesy of the Adirondack Steel Company, a sound film on the production of steel castings was shown. Discussion followed the presentation of the film.

Alumnus Speaks at Rice

M. H. Greenwood, a former student member of RICE BRANCH and now an engineer with the Southern Aircraft Co., was the guest speaker on Nov. 13. Before 40 members and guests, he gave a paper on wind tunnels, explaining the different types, the methods of testing used, and the results obtained.

ROSE POLY BRANCH held a joint meeting with the A.I.Ch.E. chapter on Nov. 5. John Krawetz, a chemical engineer from Chicago, gave a paper on "The Petroleum Industry."

SANTA CLARA BRANCH featured a paper by George Sharp at its meeting of Oct. 17. He discussed the present plans of the U. S. Maritime Commission and the developments sponsored by this group during the last ten years.

U.S.C. BRANCH at its meeting of Oct. 29 had a sound motion picture on the fabrication and performance of Lockheed commercial and military airplanes. Particularly interesting was the comparison of characteristics of the varied types of aircraft.

Southern Methodist Sends Flowers

When it was announced at the meeting of SOUTHERN METHODIST BRANCH on Nov. 20 that Prof. Ray M. Matson was ill, the members immediately approved a motion to send him flowers. After the transaction of this brief business, the members viewed motion pictures on "The Dodge Fluid Drive," and "An Evening With Major Bowes."

STEVENS BRANCH at its meeting of Nov. 13 had Paul Cherington, noted management expert, for the guest speaker. In his paper, he showed the difference between routine jobs and those needing foresight and "social dynamics," tracing much of the world's troubles to the fact that personal liberty and public welfare too often conflict. It is in this field, stated Mr. Cherington, that the future of engineers lies.

SWARTHMORE BRANCH held a "dessert" meeting on Nov. 10 at the home of Prof. Charles Thatcher, who was the guest speaker for the evening. The speaker told the students of the many types of jobs available today and what aptitudes were necessary for each one. A period of discussion and questions followed the interesting talk.

112 at Texas A.&M. Meeting

Prof. H. W. Barlow, head of the aeronautical-engineering department, was the speaker at the Nov. 14 meeting of TEXAS A.&M. BRANCH. He gave a paper on aircraft production and why there is no such thing as mass production of airplanes. Also discussed were some of the recent developments in aircraft. The meeting was attended by 105 members and 7 guests.

TEXAS TECH BRANCH members learned all about fluid drives in automobiles at the meeting of Dec. 2. M. L. Williams, Chrysler Corp., gave a lecture and demonstration on the fluid drive and its applications.

TUFTS BRANCH was highly honored on Nov. 15 when Warren H. McBryde, President of the A.S.M.E., visited it. Mr. McBryde's talk on "What Is Engineering?" stimulated some interesting discussion among the 50 members and guests. It was found that the two prime requisites for a successful engineer are the ability to take orders and to execute them and the ability to get along with men.

UTAH BRANCH had its troubles on Nov. 13. A motion picture on the history of wrought iron, which was to have been presented, did not arrive. Prof. M. B. Hogan came to the rescue with a talk on the general aspects and obligations of the mechanical-engineering profession.

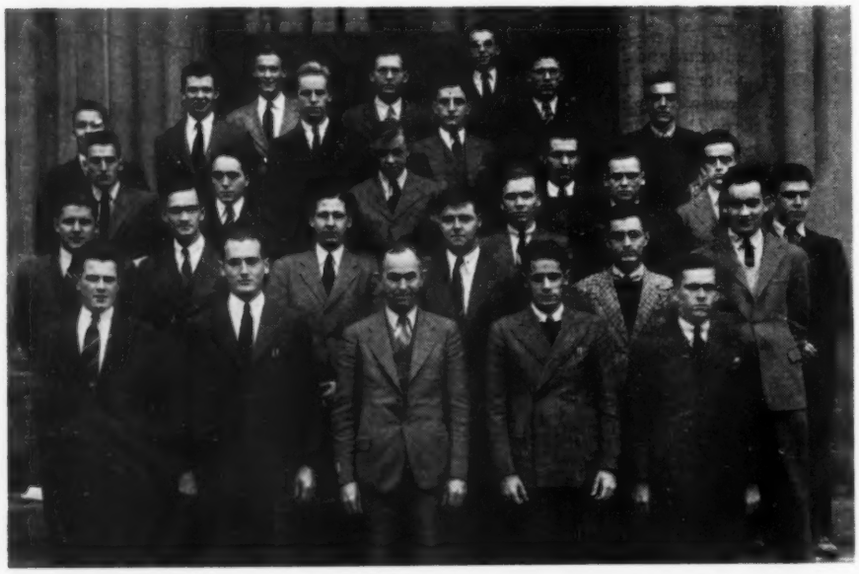
VERMONT BRANCH held a membership rally on the evening of Nov. 21. After the showing of five colored motion pictures, Chairman Ned Creed told the 20 members and 15 prospective members of the benefits of membership in the A.S.M.E. At the close of his talk, cider and doughnuts were served.

Villanova Acts as Host

November 14 was a big day in Villanova, Pa., when the VILLANOVA BRANCH played host at a smoker to student members from PENNSYLVANIA BRANCH and DREXEL BRANCH. The speaker of the evening, E. V. Jones, Philadelphia Electric Co., discussed employment problems as applied to engineering. Thanks to the work of Robert Boudon and his committee, the smoker was the most successful one ever held by the Branch.

VIRGINIA POLY BRANCH was also a host at a meeting on Nov. 9 to the A.S.M.E. Virginia Section and VIRGINIA BRANCH. After the audience of 181 was called to order by Chairman J. Q. Peeples, Dean E. B. Norris, of V.P.I., welcomed the guests. Then papers on various subjects were presented by the following student members: H. C. Hall, A. B. Terry, R. C. Thayer, and G. C. Wiatt. G. C. Molleson, chairman of the A.S.M.E. Virginia Section, and mechanical engineer with the Dept. of Public Works, Richmond, Va.,

A.S.M.E. VIRGINIA POLYTECHNIC INSTITUTE BRANCH SPONSORS INSPECTION TRIP FOR UPPERCLASSMEN THROUGH ROANOKE, VA., SHOPS OF NORFOLK & WESTERN RAILWAY



PICTURES TAKEN AT THE SMOKER ON NOV. 14 OF THE VILLANOVA COLLEGE BRANCH AT WHICH STUDENT MEMBERS FROM DREXEL AND PENNSYLVANIA BRANCHES WERE GUESTS

talked about the new marine terminal for the City of Richmond. The joint meeting was concluded with luncheon at the Faculty Club

WASHINGTON BRANCH members learned all about fish-canning machinery on Nov. 7 from Leo Cleo and Stanley Wooster, both of whom have worked in the fish canneries of Alaska during their summer vacations. Leo described the outside operations while Stan discussed the handling, canning, and cooking machinery.

WASHINGTON STATE BRANCH at its meeting of Oct. 31 was told that a Marks Mechanical Engineer's Handbook would be awarded as first prize for the best paper submitted to the committee on or before Dec. 12. Following the announcement, Louis Benner described his summer job in an Oregon gold mine.

Wisconsin Branch Holds Party

On Saturday evening, Nov. 9, WISCONSIN BRANCH held a party in the lobby of the mechanical-engineering building. The party, arranged by Arthur Burns, William Zunke, and Edwin Katz, was voted a big success by the 45 members and girls who attended. Prof. Ben G. Elliott proved to be a very able master of ceremonies.

WYOMING BRANCH had more than 100 members present at the dinner and meeting which was arranged in honor of Warren H. McBryde, President of the A.S.M.E. In his paper, "What Is Engineering and What Is Ahead for Engineers," President McBryde covered both the history of engineering and the opportunities for public service which present themselves to the young engineer. Dr. Ottis Rechard acted as toastmaster. Music for the dinner was furnished by the Wyomians, while Howard Sink gave several accordion numbers.

National-Defense Research Committee

THE National-Defense Research Committee, Dr. Vannevar Bush, member A.S.M.E., chairman, has made public a list of scientific men and engineers who have accepted appointments to work with the committee. The committee was created on June 27 by order of the Council of National Defense and consists of eight members.

Dr. Bush is coordinating the work of the committee with that of other governmental and private agencies and is maintaining direct supervision over a limited number of problems. Other members of the committee have the following assignments: Brigadier-General G. V. Strong and Rear-Admiral H. G. Bowen are responsible for the maintenance of close working relationships between the committee and the military services. The Honorable Conway P. Coe, Commissioner of Patents, is in charge of matters relating to inventions and patents and provides a direct connection between the committee and the National Inventors Council. Richard C. Tolman, vice-chairman of the committee, dean of the Graduate School, California Institute of Technology, is chairman of the division dealing with armor and ordnance; James B. Conant, president of Harvard University, of the division dealing with chemical problems; Frank B. Jewett, president, National Academy of Science and chairman of the board of Bell Telephone Laboratories, of the division dealing with communication and transportation; and Karl T. Compton, member A.S.M.E., president The Massachusetts Institute of Technology, of the work on detection, controls, and instruments.

The secretary of the committee is Irvin Stewart director of the Committee on Scientific Aids to Learning.

New N.A.C.A. Laboratory to Be at Cleveland

ON November 25, Dr. Vannevar Bush, chairman of the National Advisory Committee for Aeronautics, announced its selection of the Municipal Airport at Cleveland, Ohio, as the site for the government's $8,400,000 aircraft-engine research laboratory. This laboratory was authorized by act of Congress approved June 26, 1940, for the purpose of providing adequate facilities for scientific research on fundamental problems of engine design.

Louisiana Engineering Society to Hold 1941 Annual Meeting in New Orleans, Jan. 10–11

Advance Program of Technical Papers by Engineers of Nation-Wide Reputation

THE annual meetings of the Louisiana Engineering Society are characterized both by constantly increasing attendance and improved and diversified programs; and the meeting scheduled for January 10–11, 1941, in New Orleans, is to prove no exception with its splendid technical program of papers by engineers of nation-wide reputation. Cooperating in this meeting is the New Orleans Section of the A.S.M.E.

The advance program is as follows:

Friday, January 10

Process in Creosoting Wood, by Charles M. Kerr, American Creosote Works, Inc.

Science of Seeing, by Matthew Luckiesh, director, light research laboratory, General Electric Co.

Saturday, January 11

Problems in Steel Construction, by Mace H. Bell, A.I.S.C.

New Technique in Boiler Design, by E. G. Bailey, vice-president, The Babcock & Wilcox Co.

Radiant Heating and Cooling, by F. E. Giesecke, president, American Society of Heating and Ventilating Engineers and professor emeritus, heating and ventilating, A.&M. College of Texas

Solving the Dust and Dirt Problem Electrically, by S. R. Oren, Jr., precipitation application engineer, Westinghouse Electric & Manufacturing Co.

History of Electrical Industry in the United States and Its Influence on National Defense, by F. G. Frost

Headquarters at St. Charles Hotel

In addition to the technical program a varied program of inspection trips and entertaining social events has been arranged. Headquarters for the meeting are at the St. Charles Hotel in New Orleans.

Seventy-Three Standards Approved by A.S.A. During Year

Holds Annual Meeting in New York City, Dec. 11

SOME 200 representatives of trade, technical, and governmental groups who hold membership in the American Standards Association met on Dec. 11, 1940, at the Hotel Astor, New York, to hear Representative Hatton W. Sumners speak on "The Bearing of Standardization on the Cooperative Relations of Government and Industry;" and to discuss activities of the Association during the year just past.

Edmund A. Prentis, retiring president, called attention to the fact that the American Standards Association during the year "has been called on to fill new needs and to fit into a somewhat changed industrial pattern." He was referring, of course, to the National Defense Program, which, with its need for coordination of defense-production standards, has affected many of the year's activities. For example, it has highlighted almost all standardization work in the mechanical field. "The integration of the government's purchasing program and industry's manufacturing program into a smooth flow of production is an enormous undertaking, and one in which standards play an important part."

73 Standards Approved

Turning to the technical work, R. P. Anderson, chairman of the Standards Council, reported that during the year the Association has approved 73 standards. Among them are many specifications for materials, some important safety codes, a dozen gas-appliance standards, and many standards in the mechanical and electrical fields.

Probably the most important standard in the mechanical field to be approved during the year is one on Twist Drills. Also approved during the year are several standards for cast-iron pipe, for steel pipe flanges and fittings, and a new standard for spur gearing.

Despite the fact that the war situation in Europe has brought most international work to a standstill, the American Standards Association has kept in touch with the national standardizing bodies of other countries; and has been able to supply American companies filling foreign orders with information and with material that they could not obtain anywhere else.

1940 A.S.A. Officers

R. E. Zimmerman, vice-president of the United States Steel Corporation, was elected president of the American Standards Association for 1940. Mr. Zimmerman has served as vice-president of the Association since 1938, and has been a member of the Board of Directors since 1937, when he was nominated for membership by the American Iron and Steel Institute. Mr. Zimmerman is well known both in industrial and educational circles. R. P. Anderson of the American Petroleum Institute was re-elected chairman of the Standards Council which is in charge of all A.S.A. technical work. Dr. Anderson has taken an outstanding part in developing standardization in the petroleum industry. He has been a member of the A.S.A. Standards Council since 1934, as a representative of the American Petroleum Institute.

Midwest Power Conference to Be Held April 9 and 10 at Chicago, Ill.

THE 1941 meeting of the Midwest Power Conference will be held on Wednesday and Thursday, April 9 and 10, at the Palmer House, Chicago. This conference is sponsored annually by Illinois Institute of Technology (formerly Armour Institute of Technology and Lewis Institute of Technology) with the cooperation of seven other midwestern universities and colleges and the local sections of the Founder and other engineering societies. The conference is entering its fourth year under the present sponsorship.

The tentative program of the 1941 meeting, as outlined by the directorate of the Conference, includes sessions on central-station practice, stationary prime movers and plant auxiliaries, hydro power, electric power transmission and distribution, feedwater treatment, and industrial power plants.

The tentative program also consists of joint luncheons with the Chicago Sections of The American Society of Mechanical Engineers and the American Institute of Electrical Engineers, an All-Engineers' dinner, an inspection trip, and a smoker.

Inquiries in regard to the conference may be addressed to either Stanton E. Winston, conference director, or Charles N. Nash, conference secretary, in care of Illinois Institute of Technology, 3300 Federal Street, Chicago, Illinois.

A.S.A. to Develop Project on Statistical Control Methods

THE War Department has requested the American Standards Association to develop a standards project on the application of statistical methods of control of materials and of manufactured products. The Association called together a special committee of industrial experts familiar with developments in this field to discuss ways and means by which the work might be undertaken. This committee met on Nov. 19, 1940, at the offices of the American Standards Association and unanimously approved undertaking the project, feeling that it would be of real value to companies filling orders for military purposes as well as to the government and industrial procurement agencies.

The plan calls for the organization of a technical committee representative of all groups interested in this problem. In view of the importance of this project to the Defense Program, work will be carried forward as rapidly as possible.

Dr. R. L. Jones of the Bell Telephone Laboratories is chairman of the special committee. Other members are: L. F. Adams, General Electric Company; Harold F. Dodge, Bell Telephone Laboratories, Inc.; Stephen M. DuBrul, General Motors Corp.; Dr. John Johnston, U. S. Steel Corp.; Lt.-Col. A. B. Johnson, U. S. War Department; and John S. Tawresey, SKF Industries, Inc.

Junior Group Activities

Detroit Juniors Prepare Program for Rest of Year

MEETING on Nov. 12 at the Detroit Club, the Detroit Junior Group approved the following meeting program for the rest of the year: December, round-table discussion on registration of engineers or the progress of young engineers in industry; January presentation of paper; February, inspection trip; March, annual ladies' night; April, presentation of paper or joint meeting with student branches; and May, inspection trip.

After the foregoing business was concluded, the Group was entertained by motion pictures supplied through the courtesy of the Ford Motor Company, including a film of the 1940 Port Huron-Mackinaw Race. The meeting was finally adjourned at 11 p.m.

Milwaukee Juniors Hold Discussion on Policy

THE Oct. 31 meeting of the Milwaukee Junior Group was held at the Pfister Hotel. Despite a small attendance of only ten Juniors, a lively discussion took place on Society and Junior Group policy. It was the consensus of those present that it is necessary to have interesting programs in order to attract larger turnouts at meetings.

Philadelphia Juniors Have Two Good Talks

The Philadelphia Junior Section at its October meeting heard a fine talk on "Organization of Industry for National Defense," by Lieut. W. L. Stephens, Jr. A motion picture showing the manufacture of antiaircraft shells was shown through the courtesy of the Signal Corps.

At the November meeting, Robt. E. Oberholtzer described expertly the manufacture of axminister, velvet, and wilton rugs and carpets. A motion picture was shown to illustrate the processes and machinery involved.

Members of the Junior Section meet for dinner at the Engineers' Club before the regular meetings, entertaining the speaker of the evening. These dinners are well attended and always very enjoyable.

N.C.S.B.E.E. Meets at Charleston, S. C.

THE National Council of State Boards of Engineering Examiners held its twenty-first annual meeting at Charleston, S. C., October 28–31, 1940. Twenty-seven state boards were represented. The American Society of Mechanical Engineers was represented by Virgil Palmer and Secretary C. E. Davies. The 1941 annual meeting will be held in New York, and the date has tentatively been set for October 27–30. Officials of all national engineering societies will be invited to participate in the 1941 meeting.

Virgil M. Palmer, member A.S.M.E., Rochester, N. Y., was elected president for the coming year, and T. Keith Legaré continues as executive secretary for his eighteenth year.

The following resolution was adopted: "In order that all funds derived from fees paid by engineers and surveyors for legal registration and renewal be expended only for a state or national activity or purpose connected with the registration of engineers, at the discretion of the board or department having charge of the administration of the state registration or license law for engineers and surveyors in each state, it is recommended that all state engineering societies and local sections of national engineering societies be urged to promote appropriate action in their state that will result in full control of these funds by the said board or department."

Bituminous-Coal Industry Inaugurates Program of Research at Battelle

BITUMINOUS-Coal Research, Inc., the research agency of the bituminous-coal industry sponsored by the National Coal Association, has announced the inauguration of a 200,000-dollar program of research aimed to advance the competitive position of coal by the development of better equipment for its use in home and industry. The Battelle Memorial Institute will carry on the program.

The broad program of research will include studies of methods by which close control of heating and smokeless operation may be combined with the natural advantage of coal as a low-cost source of energy. The direct application of coal as a fuel for metallurgical and ceramic furnaces, methods for the complete gasification of coal for industrial and residential use, and the direct conversion to mechanical energy through the use of coal in a new type of internal-combustion engine are among the problems to be attacked as developed by the research program committee.

Financed jointly by the coal producers' associations, by individual producers, and by the coal-carrying railroads, the program is set up for a minimum period of three years.

A technical committee of fuel engineers representing the companies participating in the program will cooperate with the laboratory in the progress of the work. A smaller advisory group will meet with the research staff at frequent intervals to discuss the latest developments and to steer the program. At Battelle, Ralph A. Sherman, member A.S.M.E. and supervisor of the fuels division, will direct the work.

As results are obtained, they will be quickly made available to the supporters of the program through reports and bulletins. Bituminous Coal Research, Inc., also plans to be of service to the members by consultation on specific problems, by the dissemination of information in the current literature, and by coordination of research on coal in all parts of the country.

President Ell Inaugurated at Northeastern

ON Tuesday, Nov. 19, 1940, Warren H. McBryde, president A.S.M.E., was present at the inauguration of Carl Stevens Ell as president of Northeastern University, Boston, Mass. Harvey N. Davis, past-president A.S.M.E., and president, Stevens Institute of Technology, delivered the principal address at the convention. Dr. Davis and I. E. Moultrop represented the A.S.M E. at the inauguration.

United Engineering Trustees, Inc., Issues Its Report for 1939-1940

Henry A. Lardner, President, Gives Facts on Building, Funds, Library, and Engineering Foundation

THE Annual Report of the United Engineering Trustees, Inc., for 1939-1940, was issued on October 24, 1940, by President Henry A. Lardner, Fellow A.S.M.E. Mr. Lardner calls attention to the fact that the close of the thirty-sixth year of corporate existence of the U.E.T. brings much for which to be thankful.

Its investment program has stood up favorably in these difficult times, all office space in the Engineering Societies Building has been occupied, reasonable use has been made of the meeting halls, and the building itself is in good physical condition. The engineering societies, which so long ago elected to live and work together in the "union home" which Andrew Carnegie provided, have passed the experimental stage and found greater strength in the closer association.

During the last year two active trustees resigned, Colonel John P. Hogan to become President of the American Society of Civil Engineers, and past-president D. Robert Yarnall, because of pressure of his many interests. With profound sorrow, is recorded the loss by death on August 12 of Harry R. Woodrow, who held the office of assistant treasurer of the U.E.T. and then treasurer from 1936 until his death.

Financial

Because of the disturbed financial conditions prevailing throughout the year, the portfolio

has been under constant scrutiny by the Finance Committee with the advice of financial counsel and the investment advisers.

The policy followed has been, and is, primarily to safeguard principal and to the extent consistent therewith to obtain reasonable income to the departments which depend upon that income for their operations.

While it is impossible to foresee the future, it may be said that the results for the year show a further improvement in the position over that recorded for the previous year in respect of grade of securities held, current market value, maturities, cash and savings-bank deposits, and government bonds. These results have been obtained with only a relatively small reduction in income.

The depreciation and renewal fund for the Engineering Societies Building received $20,000 and the interest from its principal investment, the total addition amounting to $34,966.68. The Depreciation and Renewal Fund to offset obsolescence and depreciation of Engineering Societies Building, totals $446,731.60; a small amount against a building thirty-four years old which originally cost $1,400,000 but with a much greater present replacement cost.

The Corporation is Treasurer for Engineers' Council for Professional Development and custodian of funds of Engineering Societies Personnel Service, Inc. Relief Fund, of the John Fritz Medal Board of Award, the Daniel Guggenheim Medal Board of Award, and of contributions for specific researches undertaken by The Engineering Foundation.

Engineering Societies Building

The Engineering Societies Building has been the subject of extended study in an effort to improve its service to members of the Founder Societies. A full report from professional advisers has been obtained for this purpose. The physical condition of the building was found to be excellent. Means were considered to improve facilities, but the type of the building is against the expenditure of the money that would be required for extensive modernization. This report is now in the hands of the Trustees and definite decision as to its recommendations have not yet been made.

Necessary maintenance has been done, the usual painting and "freshening up," elevators inspected, and cables renewed when necessary. Periodic examinations by fire-insurance inspectors and safety engineers supplement inspections by the management at frequent intervals and assure proper "housekeeping." The building is adequately covered by fire, liability, and compensation insurance. The building remains tax-exempt. All space in the building, except the meeting rooms on the sixth floor which have from time to time been used by the Societies as offices, is occupied by the Founder Societies or Associates on a cooperative basis, excepting rooms given gratuitously to the National Research Council, Division of Engineering and Industrial Research; also space occupied by the Corporation and its departments, including Engineering Societies Library which latter covers more than two floors; for which no rental charge is made by the Trustees. The usual cooperation with Federal, state, and municipal governments in providing assembly space for military and educational meetings has been rendered.

Fund-Raising Investigation Committee

A report was presented to the Board of Trustees in July containing recommendations which are important and call for early appointments. The need is apparent and generally understood, that an increase in principal funds is necessary for the Engineering Societies Library in order to enable it to expand its field and better to serve the members; for The Engineering Foundation for the greater aid which it can give to the researches of the Founder Societies, "for the advancement of the profession of engineering and the good of mankind;" and for Engineering Societies Building funds for the improvement of the present building.

Engineering Societies Library

The facilities of the Engineering Societies Library during the fiscal year which ended on September 30, 1940, were used by 40,576 persons. Of these 30,181 visited it. The remaining 10,395 were persons living at a distance and assisted by correspondence. This involved making 64 extensive bibliographies, 119 translations, 21,679 photoprints, and 14 microfilms for 2478 individuals. Two hundred and sixty-five books were loaned to 221 members, 2572 letters were written in answer to inquiries for information and 4927 telephone requests were attended to.

The number of users in the year 1938-1939 was 43,110 persons. The decrease was chiefly in local use of the reading room. While it is impossible to give any definite reasons for this, it seems probable that increased professional employment has been one factor. The inability to obtain foreign periodicals also has tended toward the same end. It is gratifying that the use by nonresidents has not been lessened.

During the year 2822 books and 2765 pamphlets were added to the collection, which now contains 149,734 volumes, 7636 maps, and 4473 manuscript bibliographic searches, a total of 161,843 items. As works often occupy more than one volume, it may be interesting to note that the collection contains 92,103 separate titles.

Over eleven thousand entries were added to the classified index of technical articles, which now contains over 250,000 cards. The additions were principally upon materials testing, canals and rivers, iron alloys, and the rubber industry, but other fields were not neglected. Because of its arrangement, the index is a favorite with many readers, and enjoys growing popularity.

Acquisitions by purchase and gift amounted to 18,415 items: 3818 books, 14,468 pamphlets, 96 maps, and 33 manuscript bibliographic searches. Of these 5716 items were desirable for permanent preservation, the remainder being duplicates of books already owned or publications which were not related to our field or were of purely ephemeral interest.

As in other years, the library is indebted to members and friends for many gifts. It is impracticable to mention all our benefactors, but

SUMMARIZED FINANCIAL REPORT, SEPT. 30, 1940

Funds included:		Book value	Market value
Engineering Foundation Fund		$ 891,037.56	
Edward Dean Adams Fund		90,422.91	
Library Endowment Fund		167,442.40	
Depreciation and Renewal Fund		446,731.60	
General Reserve Fund		10,138.68	
Total		$1,605,773.15	
Investments: "Legal"	$ 451,760.63		
Nonlegal	995,708.89		
Total investments Sept. 30, 1940	1,447,469.52		$1,328,281.16
Cash uninvested	67,189.68		
Savings Bank Accounts	90,707.24		
Account Receivable	406.71		
	$1,605,773.15		
Real Estate		$1,993,793.92	
Henry R. Towne Engineering Fund Investments		40,540.63	20,952.54
Henry R. Towne Engineering Fund Univested Cash		7,967.90	
The D. Guggenheim Medal Board of Award Investments, net		15,840.00	7,568.35
The John Fritz Medal Board of Award Investments		3,500.00	3,762.50
United Engineering Trustees, Inc., Operating Assets		9,227.20	
Engineering Societies Library Maintenance Assets		14,662.89	
Gift for Endowment Committee Cash		474.94	
The Engineering Foundation—unexpended income		19,449.97	
Alloys of Iron Research—unexpended income		3,851.41	
Welding Research—unexpended income		387.10	
The Engineering Foundation Custodian Fund Cash		20,848.72	
United Engineering Trustees, Inc., Custodian Funds—Unexpended income		2,026.70	
		$3,738,344.53	

attention is directed to a few of importance. The heirs of J. Vipond Davies, member, American Society of Civil Engineers and American Institute of Mining and Metallurgical Engineers, presented Mr. Davies' professional library, including many manuscripts dealing with the projects in which he had participated. The firm of Fuller and McClintock presented a large collection of publications on water supply and valuation. Geo. A. Orrok, member, American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, and The American Society of Mechanical Engineers, presented many bound and unbound volumes of periodicals, and the McGraw-Hill Publishing Company a valuable gift of books and pamphlets. Miss L. S. Moncure Robinson presented the copy of The Public Works of Great Britain which belonged to her grandfather, the eminent engineer, Moncure Robinson. Mr. Frank N. Waterman, member, American Institute of Electrical Engineers, gave sixteen volumes of documents connected with important patent cases. The Library of Pope Yeatmen, member, American Institute of Mining and Metallurgical Engineers, upon mining and metallurgy, was presented. Miss Celestine Waldron gave a hundred volumes of periodicals.

The Engineering Foundation

The Engineering Foundation was established in 1914 "for the furtherance of research in science and engineering, and for the advancement in any other manner of the profession of engineering and the good of mankind." It is a department of United Engineering Trustees, Inc., and assists in a wide range of research projects, many of which are producing results of immediate practical value to science, engineering, industry, and the public. Most of the projects deal with scientific and engineering researches of a technical character, but some, such as Engineers' Council for Professional Development, concern nontechnical matters of interest to the engineering profession, educators, and the public. The results from the various researches are published by the appropriate professional societies, educational institutions which maintain research laboratories, and the technical press.

During the year work has progressed on fifteen projects, which involved thirty-two subjects, including the following in which the A.S.M.E. is particularly interested.

Effect of Temperature on the Properties of Metals, Project 45. Grant $2000. N. L. Mochel, chairman. A preprint of a "Report of Joint Research Committee on Effect of Temperature on the Properties of Metals," which is a progress report to the sponsor societies, was submitted to the June 24–28, 1940, meeting of The American Society for Testing Materials. This report gives information about eleven research projects on which work is in progress.

The project partially supported by The Engineering Foundation is No. 10 on Tubular Members Subjected to Internal Pressures, H. J. Kerr, chairman. The project includes seven creep tests and four tension-creep tests on carbon-molybdenum steel at 900 and 1050 F.

In addition to the grant of $2000 by The Engineering Foundation this research was supported by the following contributions:

Industry, firms in	$ 9900
American Society for Testing Materials	312
Battelle Memorial Institute	500
American Petroleum Institute	2700
Utilities Coordinated Research	1500
Total	$14912

Critical-Pressure Steam Boilers, Project 50. Grant $1000. H. L. Solberg, chairman. The experimental determination of the viscosity of steam by means of a long capillary at pressures up to 1800 psi abs and 1000 F has been completed. The effect of time upon the corrosion of ten different steels in contact with steam at a uniform temperature of 1100 F has been determined for periods of exposure of 200, 500, 1000, and 2000 hr. No evidence of spalling or cracking of the protective coating of oxidation products was noted during these tests. The results can be represented by a straight line when loss in weight by corrosion is plotted against logarithm of time. A series of 500-hour tests has been completed under steady temperature conditions at temperatures between 1000 and 1200 F. Results indicate a rapid increase in the rate of oxidation of the various alloy steels at the higher temperatures. The oxidation of steels containing 12 per cent or more of chromium is slight under all conditions encountered in these experiments. With a chromium content of 9 per cent or less, the oxidation of the steel increases markedly with decreasing chromium content. In the aforementioned tests, no evidence of cracking and spalling of the protective layer of corrosion products was noted.

As a result of funds made available through the cooperation of the United States Naval Research Laboratory, an investigation of the effect of stress upon the oxidation of various alloy steels by high-temperature steam has been undertaken. Apparatus is being constructed which will permit the simultaneous testing in tension of four sets of vertical test specimens. Each set of specimens may be held at any desired temperature up to 1200 F and may be loaded to any stress encountered in service.

In addition to the grant of $1000 by The Engineering Foundation this research was supported by the following contributions:

United States Naval Research Laboratory	$5000
Utilities Coordinated Research	750
Total	$5750

This does not include contributions by Purdue University of unknown amount.

Fluid Meters, Project 30. Grant $2000. R. J. S. Piggott, chairman. The committee has under way, at this time, two research programs of primary importance: (1) The "Nozzle Coefficient Research" which was begun at the request of the Test Codes Committee, and which after several years of field testing is now in the finishing stage of computation. A correlation of the data obtained in the investigation is being made by Messrs. Bean, Beitler, and Sprenkle and was presented at the 1940 Annual Meeting of the A.S.M.E. This is the preliminary step to the preparation of the final report on this work.

(2) The "Volume Meter Research" which is now actively under way after two years of preparation. The makers of volume meters are cooperating in this work by contributing meters for test. These have been sent to the University of Oklahoma at Norman where Prof. E. E. Ambrosius is conducting tests. The oil industry is helping with this work, particularly the Phillips Petroleum Company which has provided facilities and assistance at one of its wells for tests of the meters under field conditions. This investigation is especially important to the oil industry and it is hoped to receive substantial financial support for the investigation from the oil companies through their official organization, the American Petroleum Institute.

In addition to the grant of $2000 by The Engineering Foundation this research was supported by $1700 from firms in industry.

Lubrication, Project 23. Grant $1000. George B. Karelitz, chairman. Three projects are receiving financial assistance from the Committee; (*a*) the mathematical analysis of partial bearings of finite width, by Prof. E. O. Waters of Yale University, is now about finished. (*b*) Work of coordinating data on viscosity under pressure is proceeding under the direction of M. D. Hersey. (*c*) Experimental studies on pressure-viscosity relationships and flow at high pressure are being carried on during the summer by J. R. Muenger and an assistant at Harvard University.

Cottonseed Processing, Project 52. Grant $500. W. R. Woolrich, chairman. During the current year this research has been directed toward improvements in the pressure cooker to make it suitable for use in preliminary processing for the hydraulic press, the expeller, and the solvent methods of oil recovery. An attempt is being made to design a continuous flaking machine to displace crushing rolls, and to design a continuous pressure cooker to displace the batch type of cooker. A glass model has been built to study the rate of flow of the material in the cooker. It is intended to build a laboratory model cooker capable of processing from 500 to 1000 lb of material per hour which will take advantage of the developments from the recent research studies.

Processing experiments have been made in expressing peanut oil, linseed oil, and soybean oil. The cottonseed processing equipment can be adapted for these purposes. In cooperation with the Mississippi Agricultural Experiment Station a simple and inexpensive method has been developed for the recovery of protein prior to the oil extraction by heat-treatment and mechanical expression. A plastic composition using cottonseed hulls has been developed and it is expected that additional research will produce a material with improved properties.

In addition to the grant of $500 by The Engineering Foundation this research was supported by the following contributions:

Mellon Institute of Industrial Research	$ 980
Tennessee Valley Authority	1400
University of Tennessee Research Corp.	500
Total	$2880

(*A.S.M.E. News continued on page 88*)

BRUNING "75" PRINTER AND 154 BW DEVELOPING MACHINE

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MEN AVAILABLE[1]

MECHANICAL ENGINEER, 33, university graduate 1928. Experience: Machinery lubrication, oil-refinery instrumentation; power-plant operation and testing; automotive testing; textile-plant maintenance. Me-574.

M.I.T., graduate, with 18 years of mechanical-engineering and teaching experience, desires position as instructor of engineering or mathematics subjects, in factory, trade, or private schools. Me-575.

GRADUATE MECHANICAL ENGINEER, 26, married. Experienced in designing according to Navy Specifications, drafting, and testing of steam turbines, blowers, rotary gas burners, sales engineering, purchasing, systematizing, and bills of material. Me-576.

MECHANICAL ENGINEERING GRADUATE, Armour Institute of Technology, 1937. General Electric Company experience as student engineer, head of test, and production leader desires opportunity to solve production and industrial-engineering problems. Me-577.

EXECUTIVE, now available. Fifteen years with last employer, establishing earning power in excess of $20,000. Graduate M.E., wide experience in design, construction, and management of heavy type manufacturing plants. Me-578.

MECHANICAL ENGINEER, M.E., Stevens, 28, single. Desires position as designing draftsman on machinery. Mathematical background, three years' drafting experience, one year as designer in steel mill. Now employed, desires change. Me-579.

RESEARCH AND DEVELOPMENT ENGINEER, 28, B.S. in M.E. Experienced, familiar with design of pumping equipment, particularly that of low-pressure applications. Capable of conducting, recording, and reporting tests. Ability to work on own initiative and in harmony with associates. Me-580.

MECHANICAL ENGINEER, 27, B.S.M.E., M.M.E., desires technical machine design or teaching of machine design. Five years teaching design; 1 year's experience in technical design of automatic machinery, mechanical equipment. Now employed. Me-581.

MANUFACTURING PLANT SUPERINTENDENT OR ASSISTANT. Organizer, coordinator, thoroughly conversant all plant activities, controls for materials, production, costs. Background of industrial engineering experiences in mechanical- and electrical-products plants and in process industries. Me-582.

MECHANICAL AND ELECTRICAL ENGINEER, B.S., M.S., and M.E. degrees; registered professional engineer. Extensive experience in consultation, design, and construction of high- and low-pressure power plants for heavy and process industries. Me-583.

INSTRUCTOR IN MECHANICAL ENGINEERING, 28, single, B.S., M.S. Has taught hydraulics, thermodynamics, machine design, air conditioning, power plants, engineering economics, and laboratory work. Two years of industrial experience. Me-584.

INDUSTRIAL ENGINEER, qualified administer programs in industrial engineering or training, to act as assistant to manufacturing executive. Eighteen years' experience supervision, standards, budgets, methods improvement, cost reduction, factory planning, time-motion study. Me-585.

INVENTOR, ECONOMIST, SUPERVISOR, EMPLOYMENT MANAGER, EDITOR; keen mechanical and production analyst; graduate mechanical engineer; American, good personality; 8 years' general engineering and administrative experience. Wants position offering responsibility or opportunity. Me-586.

POSITIONS AVAILABLE

INSTRUCTOR with master's or doctor's degree in field of engineering to teach in general engineering program. Should have some teaching experience. Salary, $2000–$2200 for nine months; slightly better if applicant has doctor's degree. Southwest. Y-7097-C.

MECHANICAL ENGINEERS, 25–40, with outstanding experience in production planning, methods, processes, scheduling, and costs. Work in light and heavy machine-shop operations. Knowledge tooling beneficial. Salary, $150–$400 a month. Pennsylvania. Y-7122.

ASSISTANT SUPERINTENDENT experienced in general machine shop, gray-iron foundry, and pattern-shop and assembly-shop departments of machinery-manufacturing business. Some experience in power-plant equipment desirable, also in handling of men. Applicant will be placed in erecting shop of company manufacturing stokers. Prefer middle-aged applicant. Middle West. Y-7130-D.

CHIEF ENGINEER AND DESIGNER for plant manufacturing domestic and commercial refrigerators. Must be experienced in cabinet design and sheet-metal fabrication. Refrigerator experience preferred; not essential. Salary, $250–$300 a month depending on experience. Northwestern Illinois. Y-7132-R-890-C.

GRADUATE MECHANICAL ENGINEER with background in tool design or toolmaking, to act as outside vendor contact man. Must have personality, ability to read blueprints, knowledge of machine parts, and be able to expedite purchased parts. Salary, $50 a week plus expenses. Two men for New York State and one for Vermont. Y-7142.

ASSISTANT WORKS MANAGER in charge of production. Applicant must have good background of modern production methods in process industries; must be competent executive, capable to direct plant organization in orderly, cool manner. Salary open. South. Y-7145.

FOREMAN for pinion-cutting department. Applicants must be able to make own chucks and tools, maintain machines. Prefer applicant with Bechler or Safag pinion-cutting-machine experience. Must also have complete knowledge of leaf and pivot polishing and be capable of training and developing own employees. Salary, $65 week start. East. Y-6933.

MECHANICAL ENGINEERS wanted for large manufacturing company to check and inspect materials (machine parts, steel forgings), at plants of vendors. Applicants should be residents of Cleveland, Birmingham, Rhode Island and the New York metropolitan area. Six to eight months, possibly leading to permanency. Salary, $250–$300 a month. Y-6938.

CHIEF ENGINEER, graduate mechanical, with experience on automatic and semi-automatic machinery. Will be required to do some design, organization work, and economic studies for small manufacturing company employing about 80 men. Salary, $4500–$6000 a year. N.Y.C. Y-6944.

CHIEF ENGINEER, experienced in machine design, who has inventive ideas for company manufacturing mechanical loading equipment. Salary, $15,000 a year. East. Y-6956.

DESIGNERS AND DRAFTSMEN, mechanical, with experience in steel-mill machinery design and layout furnaces, to assist in design division during expansion program. Salary, $200–$300 a month. Location, South. Y-6967.

GRADUATE ENGINEER, either mechanical or chemical, to work in development laboratory. Must have good sound mathematical training and understand "horse-sense" application of basic engineering principles. Knowledge of any or all of the following would be helpful: Fluid or gas flows, liquid or gas metering, principles of combustion, metallurgy, gas characteristics. Must be able to do simple drafting. Salary open. New Jersey. Y-7014.

SALES ENGINEERS, 32–40, to sell asbestos and insulation material. Should have some plumbing, heating, and air-conditioning experience. Salary, $200 a month and expenses. Philadelphia, New England, and South. Y-7021.

SALES ENGINEER, graduate mechanical, preferably with some experience in sale of cutting oils. However, experience with machine tools and actual production work is essential. This experience should have been gained in production work in some machine shop of large factory or in sales or service work for one of the large machine-tool builders. Salary, about $250 a month. N.Y.C. Y-7044.

SALES ENGINEER, young, with general engineering knowledge of mechanical, electrical, and automotive engineering, for company selling Diesel engines. Should be willing to start at comparatively small salary and learn company's requirements by assisting present Diesel sales organization. Apply by letter giving complete details as to education, experience, etc. Must have own car. Headquarters, New England. Y-7045.

GRADUATE ENGINEER, 30–40, with good engineering training and wide experience in production of lime and limestone products. Should have clear knowledge of more modern processes and equipment necessary to production of various types of chemical and hydrated lime. Should have good analytical mind,

(*A.S.M.E. News continued on page 90*)

[1] All men listed hold some form of A.S.M.E. membership.

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facility for handling labor problems, and good all-around executive ability. Opportunity for advancement. Location, East. Y-7051.

CHIEF MECHANICAL ENGINEER with creative engineering ability to direct engineering department of 15 to 20 engineers. Company is one of the leading manufacturers of materials-handling equipment in country. Position permanent. Salary in excess of $10,000 a year. Middle West. Y-7059-R-901-C.

CHIEF PLANT ENGINEER for large, financially sound organization operating several steel mills. Will be in charge of maintenance and new methods of manufacture. Position is permanent and not dependent on the national emergency. Salary in excess of $10,000 a year. Location, Middle West. Y-7060-R-902-C.

GRADUATE MECHANICAL OR MINING ENGINEERS with 3 to 10 years' experience, for outstanding company in materials-handling field. All will start work on design and development of equipment and later, depending on aptitude, be assigned to sales engineering or production. Salary, $200–$300 a month depending upon experience. Location, Middle West. Y-7061-R-903-C.

MECHANICAL OR CIVIL ENGINEER experienced in complete construction of steam power plant, including all mechanical installation. Temporary, 10 to 12 months. Salary, $425 a month. Middle West. Y-7064.

GRADUATE MECHANICAL ENGINEER, 38–42, with from ten to fifteen years' experience in chemical industry. Must be thoroughly acquainted with chemical or sugar-plant machinery. Prefer man with professional license. Position on administrative staff of plant. Salary, about $400 month. New Jersey. Y-7065.

SALESMAN to sell motors in Ohio territory, with headquarters, preferably, in Cincinnati. A sales engineer having contacts in Ohio is preferred. Salary will approximate $250 a month plus bonus if the applicant has had motor-sales experience. Y-7068-R-907-C.

MECHANICAL ENGINEER, about 40, with good basic knowledge of metal trades, capable of application of good common sense in inspection of ordnance materials. Some experience in gun manufacture beneficial. Able to drive car. Temporary. Salary, $300 a month. Headquarters, New England. Y-7074.

GRADUATE ENGINEER, about 25, married, to act as foreman and take charge of limestone-quarry crushing and washing plant having capacity of 500 tons per day. Should have some knowledge of quarry or mining work, general maintenance work, and some planning ability. Essential applicant be wide-awake and cost-conscious. New England. Y-7089.

METALLURGIST, steel, preferably under 45, with some experience in making steel in electric furnace and also in a small rolling mill, especially in re-rolling of old steel. Location, Middle West. Y-7091-C.

Candidates for Membership and Transfer in the A.S.M.E.

THE application of each of the candidates listed below is to be voted on after January 25, 1941, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

Re = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and transfer to Member

NEW APPLICATIONS

For Member, Associate, or Junior

ALLEN, ELLIOTT A., Santa Monica, Calif. (Rt)
BALL, EUSTACE T., New York, N. Y.
BUNN, EDW. S., Rome, N. Y.
CONCORDIA, CHAS., Schenectady, N. Y.
COUPLAND, B. R., Los Angeles, Calif.
DAHLQUIST, JOHN LINDEN, Chicago, Ill.
DARDEN, C. M., Nashville, Tenn.
DEANE, C. A., Whitinsville, Mass. (Rt & T)
DEWEY, W. V., Chicago, Ill. (Rt & T)
DE WITT, EDW. J., Chicago, Ill.
EDWARDS, MALCOLM G., Memphis, Tenn.
EGEA, LOUIS S., Detroit, Mich.
EGLI, H., Catonsville, Md.
ELSEY, WARREN R., Wynnewood, Pa.
GARDNER, LESTER H., Baltimore, Md. (Rt)
HEMPEL, EDW. H., New York, N. Y.
JEFFERIES, FITCH B., Newark, N. J.
JOHNSON, SIDNEY, JR., South Barre, Mass.
KAYE, JOS., Everett, Mass.
KINDERMAN, WALTER J., Philadelphia, Pa.
KOFFMANN, EUGEN L., Salt Lake City, Utah
LANG, HANS J., Aruba, Curacao (Re)
LAWLER, FRANK P., CHICAGO, Ill. (Rt)
LEMMER, HORACE, Montreal, Que., Can.
LESLIE, GEO. C., Long Beach, Calif.
LIVERSIDGE, ROBT. P., Cynwyd, Pa.
MCCUAIG, DONALD H., Tuscaloosa, Ala.
MIDDLEMAN, DAVID, Baltimore, Md.
MINNS, RUPERT G., Akron, Ohio
PARKER, CLARENCE C., Birmingham, Ala.
PENNY, W. F., Hampton Bays, L.I., N.Y. (Rt)
PENTON, PAUL, Buffalo, N. Y.
PERKINS, CARL K., Belleville, N. J.
PIERCE, H. M., Wilmington, Del. (Rt)
REARICK, WALTER S., New Kensington, Pa.
REID, W. C., Flushing, L. I., N. Y.
SAFFORD, J. F., Waynesboro, Va.
SALMON, FRED A., JR., Chattanooga, Tenn.
SANDALJIAN, PETER G., Uncasville, Conn.
TICKNOR, W. A., Corning, N. Y.
VOGT, EDWIN R., Los Angeles, Calif.
WATSON, WM. MALCOLM, Beverley, Mass.
WEEKS, D. C., New York, N. Y.
WESEMANN, E. J., Valley Stream, L. I., N. Y.
WINYARD, F. W., Kowloon, Hong Kong, China
YOUNG, GERALD P., Santa Monica, Calif.

CHANGE OF GRADING

Transfers to Member

GOMPF, ARTHUR M., Baltimore, Md.
HEMPEL, HERBERT W., Belleville, Ill.
JANNETT, ANTHONY V., 3RD, Birmingham, Ala.
MAYER, J. K., New Orleans, La.
RIDDIFORD, ARTHUR B., JR., Rockford, Ill.
ROBBINS, IRVING P., Toledo, Ohio
SALISBURY, HAROLD G., Troy, N. Y.
SCHLITT, J. L., Darien, Conn.
SIMS, E. M., Norman, Okla.
SMITH, HAROLD A., Independence, Mo.
STEEN-JOHNSEN, H., Lansdowne, Pa.
THOM, GEO. B., Swarthmore, Pa.
TOMPKINS, JOHN G., White Plains, N. Y.
WOKURKA, E. O., Kirkwood, Mo.
ZAHN, O. F., Jr., Coronado, Calif.

A.S.M.E. Transactions for December, 1940

THE December, 1940, issue of the Transactions of the A.S.M.E., which is the *Journal of Applied Mechanics*, contains:

TECHNICAL PAPERS

The Impact of a Mass Striking a Beam, by E. H. Lee
Analysis of Clamped Rectangular Plates, by Dana Young
The Orthogonally Stiffened Plate Under Uniform Lateral Load, by H. A. Schade
Some Observations on the Theory of Contact Pressures, by Stewart Way
Forty-Eight Ordinate Harmonic Analysis and the Harmonic Spectrum of Two-Cycle Diesel Torque, by Nancy Klock
Turbine-Blade Vibration Due to Partial Admission, by R. P. Kroon
Convergence of Hardy Cross's Balancing Process, by Rufus Oldenburger

DISCUSSION

On previously published papers by L. M. Tichvinsky and E. G. Fischer; and R. E. Newton

Necrology

THE deaths of the following members have recently been reported to the office of the Society:

ABRAMS, HERBERT T., November 10, 1940
CURTISS, NATHAN A., June 29, 1940
FOX, WILLIAM, May 4, 1939
MONTGOMERY, ORA C., November 10, 1940
OYEN, ERLING O., June 28, 1940
PETERSON, PALMER A., September 8, 1940
PORTER, JOHN ETHAN, December 17, 1939
ROBB, A. R., October 21, 1940
ROBBINS, HARRIS A., October 25, 1940
RUDOLPHI, FRANK, October 29, 1940
SCOTT, EARL F., November 18, 1940
TRASK, WALTER H., JR., September, 1940
VAN STONE, CHARLES, May 12, 1940

Correction

THE name of Dennistoun Wood was erroneously included in the death notices listed in the December issue of MECHANICAL ENGINEERING.